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U.S. Rural electrification administration applications and loans division

SURVEY AND REPORT
OF
PRESENT AND FUTURE POWER REQUIREMENTS
OF
EAST CENTRAL ELECTRIC ASSOCIATION
(MINNESOTA 1 KANABEC)
BRAHAM, MINNESOTA

APPLICATIONS AND LOANS DIVISION
RURAL ELECTRIFICATION ADMINISTRATION
UNITED STATES DEPARTMENT OF AGRICULTURE
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SURVEY AND REPORT OF PRESENT AND FUTURE POWER REQUIREMENTS 1/

PURPOSE OF REPORT

Purposes of this report are generally to evaluate the prospects for consumption of electric power by existing and potential consumers of the East Central Electric Association, to estimate the probable power requirements of the Association's system at the end of two, five and ten years, and to investigate and tabulate specific factors affecting the serving of such loads with adequate low-cost power.

Specific purposes of the survey and report are:

(A) To permit the making of engineering and economic studies relating to the construction of generating facilities and the extension of transmission lines of the Rural Cooperative Power Association (REA designation Minnesota 70G Hennepin) to assure the Association of adequate low-cost wholesale power.

(B) To provide a foundation upon which to base a long-range retail rate structure.

(C) To furnish pertinent information in connection with a system study to be prepared by the Association.

(D) To serve as a guide for an effective power use program to be initiated and prosecuted by the Association.

(E) To arrive at an estimate of the ultimate system investment which the Association will be obliged to make in order to provide adequate central station service to all of the anticipated loads.

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The report does not purport to establish the feasibility of the Association serving all loads tabulated in the survey, nor does it intend to imply that funds are or will be earmarked by the Rural Electrification Administration for service to such loads. Each application for REA loan funds will, as in the past, be considered on its own merits.

1/ Prepared by E. F. Renshaw, Engineer, E. E. Wolter, Field Representative and W. G. Mills, Engineer, Applications and Loans Division, REA, USDA.

Drawing No. 1, attached to the report, shows:

(1) Tentatively established boundaries of the Association;

(2) Existing transmission lines in the Association's area of development;

(3) Delivery area of proposed substations;

(4) Estimated kilowatt demands and annual kilowatt hour requirements at each of the tentative substation locations for rural loads.

SUMMARY AND CONCLUSIONS

The survey of the Association's area reveals that a very substantial market for electrical energy exists on the farms, in the towns and villages and in industries served or to be served by the Association. Tables VIII to XXXIII of the Load Estimates support the conclusion that adequate low-cost power must be made available to the Association at multiple points of delivery as soon as possible if the full utilization of power on the farms is to be attained and adequate service maintained to those facilities to be acquired from the Eastern Minnesota Power Corporation.

At present the Association is serving approximately 2,500 members from approximately 960 miles of distribution lines. During 1946 a total of 4,394,000 kilowatt hours were purchased at a maximum demand of 1,434 kilowatts. Table XXXIII (Summary of Power Requirements) indicates that approximately 4,950 rural consumers will be served by the Association in 1949; 7,080 in 1952; and 8,400 in 1957, at an estimated maximum demand of approximately 3,500 kilowatts in 1949, 6,800 kilowatts in 1952 and 12,000 kilowatts in 1957. Likewise, it is estimated that the Association will have a total annual energy requirement for the foregoing rural consumers of approximately 14 million kilowatt hours in 1949, 29 million kilowatt hours in 1952 and 54 million kilowatt hours in 1957.

In addition to the above loads the Association is contemplating the acquisition of all of the distribution facilities now owned and operated by the Eastern Minnesota Power Corporation located within the towns and villages in the Association's area. Funds have already been allocated for this purpose and an early closing of the acquisition is anticipated. The property to be acquired consists of the distribution facilities in 18 towns and villages presently serving approximately 3,584 consumers (exclusive of rural consumers) with present annual power requirements of approximately

14 million kilowatt hours and an estimated maximum demand of approximately 3,300 kilowatts. Table XXXII indicates that the number of urban consumers served in the acquisition will increase to approximately 3,864 in 1949, 4,105 in 1952 and 4,483 in 1957, and will have an estimated maximum demand of approximately 3,700 kilowatts in 1949, 4,500 kilowatts in 1952 and 5,700 kilowatts in 1957. Corresponding power requirements for the same years are estimated at approximately 18 million kilowatt hours, 22 million kilowatt hours and 28 million kilowatt hours, respectively.

From the foregoing estimates it is evident that the combined rural and acquired urban distribution systems will be serving a total of approximately 8,822 consumers in 1949, 11,183 consumers in 1952 and 12,877 consumers in 1957. The sum of the non-coincident peak demands on the rural and urban systems is estimated to be approximately 7,200 kilowatts in 1949, 11,500 kilowatts in 1952 and 18,000 kilowatts in 1957. Similarly, the combined total power requirements for the corresponding years are estimated to be approximately 32 million kilowatt hours, 52 million kilowatt hours and 82 million kilowatt hours, respectively.

Exclusive of distribution lines to be acquired, it is estimated that a total of 2,535 miles (including approximately 960 miles of existing lines) will be constructed by the Association in order to serve all of the members included in the foregoing estimates of rural loads by 1957. The construction of these facilities, together with the financing of the acquisition and of necessary operating equipment, supplies and buildings, etc., will require an estimated ultimate investment on the part of the Association of approximately $4,073,000.

The Association at the present time purchases its wholesale energy requirements from the Rural Cooperative Power Association at two points of delivery, namely, Cambridge and Long Siding. The survey reveals that at least

four additional points of delivery will be necessary in order to serve all of the rural loads enumerated above, and that the Cambridge substation might better be relocated. The serving of the four additional delivery points by the Rural Cooperative Power Association will require certain additions to its existing generating and transmission facilities. All of the towns and villages within the Association's boundaries now being served by the Eastern Minnesota Power Corporation are located along the 22 kv transmission lines of that corporation, such lines paralleling to a great extent the proposed transmission lines of the Power Cooperative which would be necessary to serve these additional delivery points. This fact suggests the desirability of exhaustive engineering and economic studies to be made of the feasibility of utilizing parts of the existing transmission lines of the Eastern Minnesota Power Corporation, and the integration of these facilities with those of the Rural Cooperative Power Association, in serving the additional delivery points as well as in maintaining adequate service to the towns and villages now served by Eastern Minnesota Power Corporation.

It is not unlikely that the foregoing studies will indicate that the magnitude of loads and improved load factor resulting from the integration of these two systems having widely diversified load characteristics will insure maximum economic use of existing and proposed generating and transmission facilities, resulting in lower overall costs per kilowatt hour of delivered power.

The degree of attainment of area coverage by the cooperative as well as the achievement of the estimated kilowatt hour consumption foreseen in this report will, in a large measure, be dependent upon the availability of low cost power and a fully prosecuted power use program designed to attain the goals of saturation of appliances and farm equipment reflected by the estimates included in this report.

METHOD OF SURVEY AND SOURCE OF INFORMATION

Much of the area was visited. Pertinent information was secured from the following sources: Secretary-manager of Minnesota Resources Commission; Chief Engineer of Division of Water Resources and Engineering, State Department of Conservation; Director's office of Division of Land and Minerals; Commissioner of Iron Range Resources and Rehabilitation Commission; Office of State Forestry Division; Chief Engineer, Minnesota State Highway Department; County Agents; Project Engineer; Project manager and directors; Managers of municipal electric utility systems; and Secretary of W.A.C.K. Cooperative Electric Association, Mora, Minnesota.

Operating records of the Association were examined and analyzed to secure information relative to historical experience of member consumption.

Basic data relating to agricultural statistics and trends in the area were analyzed from Volume 1, Part 8 of United States Census of Agriculture, 1945, as published by the U. S. Department of Commerce, Bureau of the Census.

In determining the estimated average consumption per consumer for the forecast periods, consideration was given to the operating experience of the Association under study; the application of electric power to productive use determined by the prevailing types of farming and other related enterprises in the area; effect of electric service toward stimulation of new enterprises and other economic activities in the community; the general progressiveness of the rural people and their willingness to adopt new methods and techniques with the use of electricity in farming operations, and the probability of low wholesale power rates and its probable influence on electric consumption. The existence of rural industries was carefully investigated and consideration given to possible establishment of additional industries that may be served by the Association's lines. Where sufficient justification was available such loads were included in the tabulation of future

power requirements. Estimates of individual industrial loads were based on known load requirements of similar industrial plants already in operation.

A thorough investigation and analysis of all operating records and reports was made in the general and district offices of the Eastern Minnesota Power Corporation for the purpose of securing and assembling pertinent data relative to the pending acquisition of that corporation's generating, transmission and distribution facilities by the East Central Electric Association and other interested REA-financed cooperatives. The location and description of such lines and rural consumers served were secured from its map records.

Farm consumers to be served by the Association at the end of each forecast period were obtained by count from an unelectrified farm survey map prepared by the Association. Village and commercial consumers to be served on the Association's farm lines were estimated in conference with the Association's manager and personnel.

In estimating future increases in the number of consumers and kilowatt hour consumption of each class of consumer in towns and villages now served by the Eastern Minnesota Power Corporation, and proposed to be acquired by the Association, historical records of consumer and average KWH consumption increase of the company from 1936 to 1946, inclusive, were analyzed. Large power loads were analyzed and treated separately in arriving at the total estimated demands and consumption for the properties involved.

Altogether, the estimates of future loads included in the report have in a large measure been tempered by a judgment arrived at through experience and an understanding of the factors affecting the future use of electricity in rural and urban areas.

BASIC DATA RELATING TO LOAD ESTIMATES

PHYSICAL CHARACTERISTICS OF THE AREA:

The area is comprised of all or parts of eight counties located in the east central section of Minnesota. It includes all of Benton County; all of Chisago County; the southeastern quarter of Morrison County; the southern half of Kanabec County south of Mora; all except the northern quarter of Mille Lacs County; all except the southwestern quarter of Isanti County; the southern half of Pine County; and a small section of Sherbourne County in the vivinity of Santiago consisting of approximately 21 square miles. The area is bordered on the west by the Mississippi River and on the east by the St. Croix River. Numerous smaller rivers and streams, notably the Rum River and the Snake River, drain the area.

Two or more broad classifications of soil groups characterize the area under study. The Milaca-Cloquet soil series covers the greater part of the area in the western and north central section of the Association's area, while the Hayden series comprise the soils in southern Mille Lacs, Kanabec, Pine and northern Isanti and Chisago Counties in the east central part of the area. The Menahga-Zimmerman Series covers southern Isanti and central Chisago County in the extreme southeastern part of the project area. Numerous different types of soils exist in the above broader soil groups, however, the soil types in each group or series have similar surface soil or subsoil characteristics.

In the Milaca-Cloquet soil area many large and small peat bogs comprise a large part of the area. The region is characterized by extreme variations in topography, ranging from gently undulating to strongly rolling to steep and hilly. In the southern part of this soil area, which is the area with which part of this study is concerned, the surface is smoother, the slopes less steep, and more of the land is better suited for agricultural use.

The area originally was heavily forested with mixed conifers and hardwoods. Practically all of the original timber has been removed and a second growth of various species of hardwoods now covers a large proportion of the uncleared land.

Glaciers deposited the material from which the soils have developed. In some places the glacial material is uniformly fine textured such as clay loam or sandy clay loam; however, the bulk of the material consists of a loose sandy till with large and small boulders commingled with the finer-textured material. Soil erosion either by water or by wind is not a serious problem.

Marked changes in the texture of both surface and subsoil occur within short distances and almost every quarter section has some poorly drained soil or peat. The upland soils are predominately gray sandy loams and loams with reddish sandy clay loam subsoils. In the low-lying places, excluding the peat bogs, the surface soils are darker and the subsoils are somewhat heavier textured.

The productivity of the soils in the Milaca-Cloquet series ranges from good to poor. Such factors as relief, drainage, texture of surface soil and subsoil, and stoniness greatly influence the productivity and agricultural use of these soils. The most productive ones are those that are well drained. Their natural supply of organic matter and nitrogen are low, compared with the black soils of the prairie region. This necessitates the growing of clover or alfalfa which, along with the use of manure produced on the farm, furnishes a supply of organic matter sufficient to maintain productivity at a fair level.

The soils of the Hayden series in the southern part of the Association's area have developed under a forest vegetation. They occur in a region where the growing season is longer and the precipitation more abundant, and thus

have a wider adaptation of crops. The surface ranges from undulating to strongly rolling with many depressions, swales, and peat bogs, intermingled with higher, better drained land.

The principal soil types on the undulating and rolling uplands are Hayden loam, Hayden fine sandy loam and Bradford loam. The soils in general are productive. Corn, small grains such as oats and barley, tame hay including the common clovers, and alfalfa are the crops most commonly grown. Nearly all the soils are well adapted to alfalfa and sweet clover, since the supply of lime in the soil in most cases is adequate for their growth. Dairying is the principal enterprise. Vegetable gardening, poultry raising, and the production of apples and small fruits are also important.

The Menagha-Zimmerman soil series occupies a comparatively small part of the area. This series is slightly more gravelly and porous than the other two major types discussed above. The materials on which the soils have developed are of glacial origin. Groves of trees and the rolling topography prevent, to a great extent, the blowing and erosion which occurs on this series in other less protected areas. The soils are generally acid and often require some liming for such crops as alfalfa and sweet clover. Zimmerman loamy fine sand, developed under a forest vegetation of scrub oak, is the dominant type of soil found in this series in the project area. General farming is practical, with dairying the most important.

The average annual temperature in Minnesota ranges from 35° F along the northern border to 45° in the southeastern corner with an average of 41° for the state as a whole. The average annual temperature of the area under study is about 41 to 42 degrees. Summer temperatures above 90 degrees F. and winter temperatures below 20 degrees are not uncommon. The coldest month is January, and the warmest is July.

The average annual precipitation of the area is about 26 inches. Less precipitation occurs in the winter months than in the other months of the

year. Beginning with May and continuing until August, when crops are making their heaviest demands on water, 55 percent of the annual rainfall is normally received. Evaporation is less rapid in Minnesota than in states farther south and consequently, the demands of vegetation for water are not so great; therefore, the average annual rainfall of 26 inches in this area is more effective in crop-producing power than greater amounts in areas farther south.

The length of the growing season is of sufficient duration for the maturing of all common agricultural crops adapted to this section of the country. The number of days without killing frosts in the area is about 130 days.

TYPES OF FARMING:

Dairying and the raising of feed for dairy cattle and livestock is the major farming enterprise in the area. General farming is also practiced including the raising of livestock and poultry. Most of the farm operators engage in dairying, livestock and poultry production together with the growing of hay and small grains. The growing of cash crops is of lesser importance in the overall scheme of farming in the area.

A classification of the types of farms in the area according to the U. S. Census of Agriculture, 1945, is tabulated below:

	Number (1945)						
Type of Farm	Benton County	Chisago County	Isanti County	Kanabec County	MilleLacs County	Morrison County	Pine County
All crop farms	10	67	129	24	36	48	33
Dairy farms	676	1177	785	1027	1132	1413	2190
Poultry farms	75	114	113	77	119	83	92
Livestock farms	228	108	128	114	103	416	144
General farms	422	315	483	223	385	945	301
Farms producing for home use	83	77	66	130	182	389	276
Other	9	4	4	4	7	16	34
Total	1503	1862	1708	1599	1964	3310	3070

Types of Farms	Total Number Farms (all counties)	Percent of Total Farms
All crop farms	347	2.31%
Dairy farms	8400	55.95%
Poultry farms	673	4.48%
Livestock farms	1241	8.26%
General farms	3074	20.47%
Farms prod. for home use	1203	8.01%
Other	78	.52%
Total	15016	100%

From the above it is seen that more than 55 percent of all farms in the cooperative area are classified as dairy farms. County Agents in the area are inclined to attribute an even greater percentage of the number of farms to dairying since practically all farms practice dairying to a greater or lesser extent. Dairy herds will average 15 to 20 cows milked per dairy farm.

The raising of poultry is important in the area with approximately 5 percent of the farms being classed as poultry farms. Nearly all farms, however, are engaged in poultry production along with other types of farming enterprises. The raising of turkeys in the area is being encouraged by the Land O'Lakes Creameries, Incorporated which expects to furnish poults to farmers and market turkey products through proposed processing plants to be financed by that corporation.

Hogs and sheep are of secondary importance in the area with some sections predominating in this minor enterprise. The raising of hogs is mostly for home consumption. Wool from the area is purchased by the Minnesota Wool Pool and assembled in Minneapolis for shipment to Boston, Massachusetts, while a small amount of wool is bought by local woolen mills.

FARM INCOME:

Farm incomes in the area are derived largely from the sale of dairy products, livestock, poultry and poultry products, cash grain crops, hay, and other miscellaneous products. Gross annual incomes per farm are fairly uniform throughout the several counties served and average approximately

$2500 per year per farm. Annual income of farms in Chisago and Benton Counties is slightly higher and averages approximately $3000.

Income from dairy products is derived largely from the sale of whole milk. In 1945, 10,492 farms in the area reported the sale of whole milk and 3,326 farms reported the sale of cream. In 1940, 12,420 farms reported the sale of cream while only 2,049 farms sold whole milk. The shift to sale of whole milk is universal throughout the area and this trend has no doubt increased from 1945 to the present time. The trend has been largely the result of higher prices paid for milk and also to the establishment of large milk drying plants in the area by Land O'Lakes Creameries, Incorporated which did not operate in this area until after 1940. Numerous small creameries in the area at present buy whole milk, extract the butterfat and sell skim milk to Land O'Lakes Creameries or other powdered milk plants.

Authorities in the area are convinced that the shift to sale of whole milk in the area is permanent, though slight shifts may occur in the future due to fluctuations in the prices paid for whole milk and cream. Large investments in powdered milk plants at present is indicative of the belief by those closest to the milk industry that the processing of whole milk in the area will be a permanent activity.

Basic data relating to income from the sale of farm products has been compiled for each of the several counties from the 1945 Census of Agriculture and is tabulated in Table I. A comparison by groups of gross farm incomes in 1944 is shown in Table II.

TABLE NO. I

BASIC DATA RELATING TO AGRICULTURE

	Benton County	Chisago County	Isanti County	Kanabec County	Mille Lacs County	Morrison County	Pine County	TOTALS
Number of farms	1516	1878	1756	1625	1976	3330	3096	15,177
Average size farms (acres)	163	127	142	139	113	161	139	140
Farms electrified (number)	493	879	519	615	740	1213	1453	5,912
Percent of farms electrified	32.5	46.8	29.6	37.8	37.4	36.8	46.9	39.0
Value of:								
All crops sold	$ 162,617	$ 212,662	$ 403,841	$ 63,890	$ 132,113	$ 177,794	$ 267,081	$ 1,419,998
All livestock & livestock products sold, except dairy, poultry and poultry products	1,306,961	1,158,875	841,320	904,821	985,446	2,156,740	1,244,055	8,598,218
Dairy products sold	1,732,230	2,764,855	1,750,176	1,940,846	2,377,732	2,955,652	3,761,776	17,283,267
Poultry & poultry products sold	879,809	972,357	695,854	551,537	794,040	1,008,608	655,486	5,557,691
Forest products sold	4,762	19,573	21,950	26,606	20,694	51,955	70,296	215,836
All farm products sold	3,886,379	5,128,322	3,713,141	3,487,700	4,310,025	6,350,749	5,998,694	32,875,010
Farm products used by farm household	700,783	544,730	478,053	639,262	781,732	1,579,388	1,064,611	5,788,559
Total value all farm products sold or used by farm household	4,587,162	5,673,042	4,191,194	4,126,292	5,091,757	7,930,137	7,063,305	38,662,889
No. farms reporting	1,503	1,862	1,708	1,599	1,964	3,310	3,070	15,016
Average value per farm	3,052	3,047	2,454	2,581	2,593	2,396	2,301	2,575

Source: U. S. Census of Agriculture, 1945

TABLE II

PERCENT OF FARMS BY TYPES - 1945 Census

Type of Farm	Counties							
	Benton	Chisago	Isanti	Kanabec	Mille Lacs	Morrison	Pine	Overall Total
All crop farms	.67	.44	7.55	1.50	1.83	1.45	1.07	2.31
Dairy farms	44.98	63.21	45.96	64.23	57.64	42.69	66.16	55.94
Poultry farms	4.99	6.12	6.62	4.82	6.06	2.51	3.00	4.48
Livestock farms	15.17	5.80	7.49	7.13	5.24	12.57	4.69	8.26
General farms	54.69	16.92	28.28	13.95	19.60	28.55	9.80	20.47
Farms producing for home use	5.52	4.14	3.86	8.13	9.27	11.75	8.99	8.01
Other	.60	.02	.02	.03	.04	.05	1.11	.52

PERCENT FARMS BY INCOME GROUPS - 1945 Census

Income Group	Counties							
	Benton	Chisago	Isanti	Kanabec	Mille Lacs	Morrison	Pine	Overall Total
$ 0 - $ 250	2.8	5.2	5.4	4.2	4.1	4.2	4.9	4.6
250 - 399	2.0	2.6	3.3	2.8	1.7	2.9	3.5	2.9
400 - 599	3.0	3.1	4.3	5.1	3.1	3.4	4.0	3.8
600 - 999	5.2	6.2	7.4	5.4	7.0	8.7	9.7	7.8
1,000 - 1,499	7.3	7.7	11.0	9.7	9.9	12.1	13.6	11.0
1,500 - 2,499	25.8	21.7	25.5	28.3	26.7	28.2	15.1	24.8
2,500 - 3,999	31.0	30.0	27.4	28.8	32.8	27.4	24.3	29.2
4,000 - 5,999	16.5	15.7	9.9	11.1	11.7	10.4	9.1	11.9
6,000 - 9,999	5.2	6.2	2.8	2.9	2.6	2.2	2.4	3.4
10,000 - Over	1.2	1.3	.4	.8	.5	.3	.5	.6

SIZE OF FARMS:

The rural areas of this section of the state are fairly thickly and uniformly settled. In the areas suitable for agriculture, four to five farms are to be found on most every section of land as evidenced by the Association's unelectrified farm maps. The average size of farms in the area is approximately 140 acres. Slightly larger farms with more tillable acres are to be found in Benton and Morrison Counties, the average in these two counties being approximately 160 acres. The predominant size farms in all counties of the area is between 80 and 120 acres.

A slight decrease in the number of farms and an increase in size of farms in 1945 over that in 1940 is shown by comparison of the 1945 and 1940 Censuses. This change is practically universal and those in position to judge the area under study feel that, hereafter, the number of farms in the area will be more or less stable. Tillable acres is likely to increase through drainage of peat bogs and additional clearing, though no appreciable increase is expected in this respect. Payments by County Agricultural Conservation Associations for drainage of peat bogs is practiced and results of this program are evident in the area.

CONTRIBUTION OF FARM PRODUCTION TO FAMILY LIVING:

Farms in the area produce approximately one-third to one-half of the total food supply used by the average farm family. More than 23 frozen food locker plants are patronized by farmers in the Association's area. Milk, butter and poultry products as well as the production of vegatables and fruits add to the products used on the farms. Census data indicates that the value of products used by farm households averaged from $300 to $500 per farm in 1944 in the several counties under study.

Part-time work off farms is not important in the area from the standpoint of added income to farmers. Little opportunity exists in the area

for work off farms other than in service trades, creameries, milk hauling and other miscellaneous activities. The number of non-farm consumers in the rural areas is therefore comparatively small. Income of non-farm families in the area will compare favorably with that in other localities for work in service trades, milk hauling and to some extent in small saw-mills in the area.

NATURAL RESOURCES:

The most important natural resource of the area is its soil and products of the soil. This natural resource is being translated into the production of quantities of corn, oats, barley, rye, flax, potatoes, hay, hogs, cattle, calves, lambs and sheep, milk, butterfat, chickens, eggs, turkeys, wool and other products. Industries stemming from this great resource consist of private and cooperative creameries, powdered milk plants, cheese factories, refrigerated food processing and locker plants, commercial feed mills, evaporated milk plants, canning plants, ice cream plants, pasteurization plants, woolen mills, hatcheries, and flour mills located in the area to be served by the Association.

Of secondary importance in natural resources of the area is its forest products. Poplar, birch, spruce, and jack pine species have been employed into useful industrial materials. Pulp, paper, insulation, and other wood products industries in adjacent areas, notably St. Cloud, furnish a convenient market for such forest products produced in the area. Another consideration of the forest resources in the area is the continuing value of this important resource as fuel, namely firewood. This represents the largest single use of any of the forest products in the area under study.

Minnesota is also rich in peat deposits. The acreage in the state is estimated at 6,217,100 containing about 6,835,300,000 tons of peat, which is roughly 50 percent of the peat reserves of the nation. While the larger

deposits of peat are located outside the Association's area, substantial deposits are to be found in Isanti, Mille Lacs, Morrison and Pine Counties. The principal interest at present in Minnesota peat as a fuel is its availability for the reduction of iron ores. Large quantities of peat are used for chicken litter. It is superior as a packing material, especially for perishable goods. Peat is an excellent non-conductor of heat. It has been considered for use in paper manufacture, in coarse fabrics such as horse blankets, as a source of dyes, insulating material, tanning material, and for antiseptic and deodorizing purposes. Sphagnum moss from the surface of peat bogs was used during the war for surgical dressing in place of cotton.

The production of power by peat-producer plants has been suggested, particularly in the northern part of the state. The low heat value of peat, combined with its cost of transportation, discourages for the time being its use as a fuel in any other way.

The University of Minnesota in cooperation with the State Legislature has conducted research on the industrial use of peat. The Iron Range Resources and Rehabilitation Commission of the State of Minnesota has constructed an experimental plant four miles west of Floodwood, Minnesota to process sphagnum moss on a commercial scale into poultry litter, for chicken and turkey raisers, as well as for horticultural purposes. This plant is the only one of its kind in the world, with specially designed machinery to process peat. The plant has a production capacity of 750 bales a day weighing 80 to 100 pounds per bale. Present plans call for around- the-clock operation to meet the demand for peat moss in the field of horticulture, and for poultry and stable litter. Research work will also be conducted in this plant with the hopes of developing other useful products from peat.

Though it is not unlikely that additional developments in peat processing will continue during the next ten years and may contribute materially to the demands for power in some parts of the area, no definite development can be foreseen at the present time in the Association's area. Therefore, no estimates of power consumption in peat processing have been included in this report.

Granite is also found in the area as is limestone and marl. St. Cloud, on the western boundary of Benton County, called "The Granite City," has become the second largest monumental granite center of the United States. Two granite industries are now served by Eastern Minnesota Power Corporation, one a quarry in northern Mille Lacs county, and the other, the Braham Granite Works (monuments) at Braham, Minnesota.

There is one additional natural resource of the area which exists in the form of its many small lakes and streams, affording the opportunity for recreational development and tourist attrations. Though the area at present does not compare in these respects with areas farther north, nevertheless, considerable recreational activity is present during the summer months. As the natural facilities afforded in other areas are occupied, additional development in this area can be expected. The Association now serves 46 seasonal cottages located on Rush Lake, Pokegama Lake, Spectacle Lake, Little Rock Lake and others in its area. Additional cottages on existing lake developments as well as on new developments on other lakes in the area are certain to continue though the increase in this activity is not expected to be large or rapid.

MARKETING FACILITIES AND OUTLETS:

The most important demand for marketing outlets in the area is for dairy products produced on farms. This demand is adequately provided by existing creameries and milk processing plants located in most every

important town and village thorughout the counties of the area. Land O'Lakes Creameries, Incorporated, operates dry milk plants in each of the towns of Foley, Rush City, Mora, Milaca and Pine City immediately within the Association's boundaries. Additional milk processing plants and creameries are located within the area or in adjacent accessible areas.

A list of creameries and other milk processing plants and their locations are shown below for the area under study.

CREAMERIES

Name	Location
Dairyland Co-op. Creamery Co.	St. Cloud
Farmers Creamery Co.	St. Cloud
Farmers Co-op. Cry. Co.	Sauk Rapids
Foley Co-op. Cry. Ass'n.	Foley
Gilman Co-op. Cry.	Gilman
Glendorado Co-op. Cry.	Princeton
Oak Park Co-op. Cry. Ass'n.	Oak Park
Rice Farmers Co-op. Cry.	Rice
Almelund Cry. Co.	Almelund
Chisago City Co-op. Cry.	Chisago City
Harris Co-op Cry. Co.	Harris
Lindstrom Cry. Co.	Lindstrom
Maple Island Farm, Inc.	Rush City
Rush City Co-op. Cry. Co.	Rush City
Shafer Creamery Co.	Shafer
Taylor Falls Creamery	Taylor Falls
Braham Co-op. Cry.	Braham
Cambridge Co-op. Cry.	Cambridge
Dalbo Creamery Co.	Dalbo
Day Co-op. Creamery	Day (Braham Rt. 1)
Spring Lake Co-op. Cry. Ass'n.	North Branch
Brunswick Co-op. Cry. Ass'n.	Mora (Rt.2)
Farmers Co-op. Cry. Ass'n.	Grasston
Farmers Co-op. Cry. Co.	Mora
Farmers Co-op. Creamery Co.	Ogilvie
Bock Co-op. Creamery	Bock
Farmers Co-op. Cry. Co.	Foreston
Farmers Co-op. Cry. Co.	Milaca
Farmers Co-op. Cry.	Pease
Princeton Co-op. Creamery	Princeton
Rum River Creamery	Milaca
Buckman Farmers Co-op. Cry. Ass'n.	Buckman
Clover Belt Co-op. Cry. Ass'n.	Hillman
Farmers Co-op. Cry. Ass'n.	Little Falls
Hillman Co-op. Cry.	Hillman
Little Rock Cry. Co.	Royalton
Ramey Farmers Co-op. Cry.	Foley (Rt. 2)

(Creameries continued)

Royalton Co-op. Cry. Ass'n.	Royalton
Sobieski Farmers Cry.	Little Falls
West Side Co-op. Cry. Ass'n.	Little Falls
Brookpark Co-op. Cry.	Brook Park
Cloverdale Farmers Co-op. Cry.	Hinckley (Rt. 3)
Co-op. Creamery of Beroun	Beroun
Hinckley Co-op. Creamery	Hinckley
Pine City Co-op. Cry. Ass'n.	Pine City
Pine City Dairy	Pine City
Rock Creek Co-op. Cry. Ass'n.	Rock Creek
Royal Co-op. Cry. Co.	Braham
Santiago Co-op. Cry.	Santiago

CREAMERIES OPERATING CONDENSERS

Land O'Lakes Dairy Co., Inc.	Rush City
Maple Island Farm Inc.	Rush City
Land O'Lakes Creameries, Inc.	Mora
Land O'Lakes Creameries, Inc.	Milaca
Pine City Dairy	Pine City

DRY MILK PLANTS

Land O'Lakes Creameries, Inc.	Foley
Maple Island Farm Inc.	Rush City
Land O'Lakes Dairy Co. Inc.	Rush City
Land O'Lakes Creameries, Inc.	Mora
Farmers Co-op. Cry. Ass'n.	Milaca
Land O'Lakes Creameries, Inc.	Milaca
West Side Creamery	Little Falls
Land O'Lakes Creameries, Inc.	Pine City
Pine City Co-op. Cry. Ass'n.	Pine City
Pine City Dairy	Pine City
Braham Co-op. Creamery Ass'n.	Braham

CHEESE FACTORIES

Brennyville Cheese Co.	Foley (Rt. 4)
Taylor Falls Creamery	Taylor Falls
Dalbo Creamery Co.	Dalbo
Farmers Co-op. Cry. Co.	Ogilvie

PASTEURIZATION PLANTS

Sauk Rapids Dairy Bar	Sauk Rapids
Amos & Andy Dairy	Rush City
Chisago Lakes Dairy	Lindstrom
Cambridge Dairy	Cambridge
Pine City Dairy	Stanchfield
Farmers Co-op. Creamery	Mora
Princeton Dairy	Princeton

(Pasteurization Plants - cont'd)

Rum River Cry.	Milaca
Farmers Co-op. Creamery	Little Falls
Sanitary Dairy	Little Falls
Hinckley Co-op.	Hinckley
Pine City Co-op. Cry.	Pine City

Numerous refrigerated locker plants are located throughout the area of the Association. A list of these follows:

LOCKER PLANTS

Name	Location
Pick Food Processing Co.	Braham
A. C. Engberg	Cambridge
Isanti County Co-op. Ass'n.	Cambridge
Clarence R. Peterson	Chisago City
Day Locker Plant	Braham (Rt. 1)
R. E. Wendberg	Dalbo
James Kotsmith	Foley
John Gotvold	Hillman (Rt. 2)
Les Starken	Hinckley
Oleson & Son Locker Co.	Isanti
Howard I. Nelson	Lindstrom
Freedhem Co-op. Cry. Ass'n.	Little Falls (Rt. 4)
Little Falls Packing Co.	Little Falls
Russell Creamery Co.	Milaca
Gordon Mork	Mora
Clayton Anderson	North Branch
Fairway Market Locker System	Onamia
Locker Association	Santiago
Rapids Refrigerated Lockers	Sauk Rapids
The Modern Store	Shafer

Feed mills are to be found in most of the towns and villages located within the area of the Association. Most of these are served with electricity from the lines of Eastern Minnesota Power Corporation while some are operated by Diesel power. Two feed mills are served by the Association. At least two flour mills are located within the area, one at Rush City operated by the Farmers Union Grain Terminal Association, and the other at North Branch operated by the North Branch Milling Company.

Woolen mills are located in Braham and Cambridge.

The area is adequately served with rail facilities by the Northern Pacific Railway and the Great Northern Railway companies. The Minneapolis, St. Paul and Sault Ste. Marie Railway traverses the northwest section of the Association's area serving the area around Little Falls as well as the area immediately north of that of the Association. Hardly any point in the entire area is more than ten miles from rail facilities.

The Northland Greyhound lines and the Clipper Bus Lines furnish bus service between all major points in the area.

The area has an adequate system of highways though some improvement in its secondary roads is needed. Heavy trucking is handicapped in some parts of the area by the necessity of placing load limits on some of the roads. Thawing and the frequent appearance of "frost boils" is a menace to good maintenance of some of the secondary roads.

OTHER FACTORS:

There appears to be no imminent possibility of the development of low cost hydro power for this section of the state. This factor has been somewhat offset in the development of the Rural Cooperative Power Association facilities which will be able to furnish adequate power at reasonable wholesale rates to its member cooperatives.

Competition afforded by LP gas in the area is significant and will be a factor affecting the consumption of energy by the Association's consumers. From a recent survey conducted by the Association, it has been estimated that approximately 25 percent of its present consumers use LP gas for cooking. Distributors of LP gas in the area are aggressively promoting the use of gas and no doubt this activity will continue.

The area is inhabited almost entirely by a people of Scandinavian descent with some German and Danish living in certain sections. These people are progressive and thrifty and are quick to adopt new methods and

techniques with the use of electricity in farming operations. They are participants in cooperative organizations of all types in the area. Cooperative marketing agencies constitute a significant fraction of the area's commerce.

The U. S. Census of Agriculture indicates that 7,635 farms in the area had tractors in 1945 compared with 4,249 tractors in 1940. This is an increase of approximately 80 percent in five years. More than 50 percent of the farms used tractors in 1945 and the number has no doubt increased since that time. It is estimated that approximately 45 percent of the Association's present farm members have electrically operated milking machines.

There is perhaps no greater opportunity or need for the use of electricity in farming operations than in dairy farming. Numerous uses of electricity exist in dairying activities such as usage for milking machines, stock water pumps, cream separators, milk coolers, dairy water heaters, milk pasteurizers, feed grinders, grain and roughage blowers, barn cleaners, ventilating fans, barn and milk house lights, and hay driers to mention a few. Indications point to a high and rapid acceptance in the use of these and other labor saving devices afforded by the availability of electricity to farmers in the area.

Indeed the survey indicates a bright future for the Association if adequate low-cost power is made available and if the Association pursues an aggressive power use policy and power use program designed to take full advantage of the opportunities described.

SOURCE OF SUPPLY

The Association is a member of the Rural Cooperative Power Association (Minnesota 70G Hennepin) and purchases all of its power requirements from that source. Power is supplied by means of its 34.5 kv transmission lines to two step-down substations, one located at Long Siding (600 kva) and the other 2 miles north of Cambridge (1000 kva). Four additional points of delivery for power from Rural Cooperative Power Association are tentatively planned for purposes of load estimating, the locations of which are shown on Drawing No. 1. Locations of these proposed substations are substantially the same as those tentatively planned by the Association's engineer.

The Eastern Minnesota Power Corporation (acquisition of which is now pending) generates part of its power requirements and purchases the balance. A Diesel electric generating station having approximately 950 kw useable capacity is operated at Milaca. Cost of power generation at this plant during March 1947 was approximately 1.27¢ per kwh. A steam electric generating station having approximately 1800 kw useable capacity is operated at Pine City. Cost of power generation at this plant during March 1947 was approximately 1.67¢ per kwh. A hydroelectric generating station located near Pine City is non-operative at this time due to the Washing out of the dam.

An interchange of power agreement is now in effect between Eastern Minnesota Power Corporation and the Wisconsin Hydroelectric Company whereby each company agrees to furnish excess power over and above its own requirements as they are able at a flat rate of 6.5 mills per kwh. Wisconsin Hydro further agrees to furnish dump power when it is available and can be used by Eastern Minnesota at 3 mills per kwh. Power cost to Eastern Minnesota under this contract during March 1947 was approximately 6.27 mills per kwh. This interchange is effected by means of a 66 kv transmission

line extending from the Wisconsin state line to Pine City.

The bulk of the Eastern Minnesota Power Corporation power requirements are purchased under a contract with the Northern States Power Company. Power is delivered at the St. Croix hydroelectric generating plant of Northern States to a 22 kv transmission line of Eastern Minnesota Power Corporation.

During the month of March 1947 the Eastern Minnesota Power Corporation generated and purchased a total of 1,766,057 kwh at an average cost of 1.304¢ per kwh. The maximum demand thus far recorded by this system occurred at 10:44 A.M., May 13, 1947, and the individual source demands were as follows:

	Milaca Plant	Pine City Plant	N.S.Pr. Co.	Wisc. Hydro.	Total
Kilowatt Demand	850	650	2500	750	4750

OTHER UTILITIES

In addition to the East Central Electric Association, three large power companies, three municipally operated electric utilities, and two other farm electric cooperatives operate in the area included in the optimum boundaries of this Assoication.

The Eastern Minnesota Power Corporation serves the majority of the incorporated and unincorporated towns and villages as well as parts of the rural areas from Pine City and Rush City on the east to Gilman and Pease on the west. The extent of its coverage and the towns which it serves are discussed in more detail under another section of this report.

The Northern States Power Company serves a number of villages and approximately 200 farms in southeastern Chisago County. This company also serves St. Cloud, Asuk Rapids and Foley as well as a few farms in southwestern Benton County.

The Minnesota Power and Light Company provides electric service to the towns of Little Falls, Royalton, Rice, Pierz and Buckman in addition to approximately 250 farms in the extreme northwestern corner of the project area in Morrison County.

The villages of North Branch, Mora and Princeton own and operate generating and distribution facilities in their respective corporate limits.

The W-A-C-K Cooperative Electric Association purchases wholesale power from the village of Mora and operates approximately 85 miles of 2400 volt distribution line serving approximately 260 farms, 83 of which are situated south of Mora within the optimum project area of the Association.

A similar cooperative organization serves approximately 7 non-farm consumers outside thc corporate limits of the village of Princeton, purchasing wholesale power from the municipal utility in the village.

The area to the south of the project is served by the Anoka County Cooperative Light and Power Association (Minnesota 48 Anoka) with headquarters at Anoka, Minnesota. The area to the west adjacent to the project area, west of the Mississippi River, is served by the Stearns Cooperative Electric Association (Minnesota 34 Stearns) with headquarters at Melrose, Minnesota.

The Mille Lacs Region Cooperative Power and Light Association (Minnesota 81 Aitkin) with headquarters at Aitkin, Minnesota serves the area adjacent to the northwest, while the North Pine Electric Cooperative, Incorporated (Minnesota 89 Pine) with headquarters at Finlayson, Minnesota serves the area adjacent to the northeast boundary of the Association. The area east of the St. Croix River in Wisconsin is served by the Polk-Burnett Electric Cooperative with headquarters at Centuria, Wisconsin.

The Rural Cooperative Power Association (Minnesota 70G Hennepin), an organization of REA-financed distribution cooperatives, owns and operates electric generation and transmission facilities serving all of the wholesale power requirements of Minnesota 1 Kanabec, Minnesota 48 Anoka, Minnesota 58 Kandiyohi, Minnesota 62 Wright-Hennepin and part of the power requirements of Minnesota 34 Stearns.

TYPES OF LOADS TO BE SERVED

The loads which are served now, or which may be served in the future, by the Association are discussed in the following pages. Part 1 of this section will treat the types of loads presently served on existing lines of the Association as well as on future lines to be constructed in rural areas. Part 2 will treat the loads to be acquired in the 18 towns and villages now served by the Eastern Minnesota Power Corporation. As materials become available and feasibility is established the Association contemplates an extensive construction program to serve the remaining number of unserved farms and other loads within the area.

Part 1 - Rural

The Association began operations in 1938 and has consistently grown until at the present time there are approximately 960 miles of line in operation serving approximately 2,500 consumers, more than 2,100 of which are farm members. Tables III (a) and III (b) show the rate of growth of the Association in number of consumers served, as well as the rate of increase in kilowatt hour consumption, by classes of consumers since 1938. Future growth in number of consumers and the rate of increase in kilowatt hour consumption, by classes of consumers, is discussed for each class of consumers in the following paragraphs.

Farms: The rate of increase in the number of farm consumers to be served by the Association is expected to be rapid inasmuch as the percent of farms electrified in the area is approximately 39 percent at the present time. The unelectrified farm survey conducted by the Association indicates that more than 5,000 farms within its boundaries are still without electric service. The acquisition of the Eastern Minnesota Power Corporation properties will facilitate the extension of service to a large number of these farms. Funds in the amount of $790,000 have already been allocated for

TABLE III (a)
COMPARATIVE ANNUAL OPERATING STATISTICS
AVERAGE ANNUAL CONSUMERS SERVED

MINNESOTA 1 KANABEC

	FARM		NON-FARM		COMMERCIAL		LARGE POWER		OTHER		TOTAL	
YEAR	NUMBER	%INCR	NUMBER	%INCR	NUMBER	%INCR	NUMBER	%INCR	NUMBER	%INCR	NUMBER	%INCR
1938	130	-	12	-	11	-	2	-	12	-	167	-
1939	465	257.7	25	108.3	40	263.6	4	-	31	-	561	235.9
1940	652	40.2	43	72.0	*110	175.0	-	-	-	-	805	43.5
1941	961	47.4	67	55.8	140	27.3	-	-	-	-	1168	45.1
1942	1207	25.6	99	47.8	154	10.0	-	-	-	-	1460	25.0
1943	1247	3.3	104	5.0	*87	-6.5	-	-	57	-	1494	2.3
1944	1369	9.8	108	3.8	*84	-2.1	-	-	57	-	1618	8.3
1945	1571	14.8	120	11.1	*148	6.4	-	-	*2	-	1840	13.7
1946	1924	22.5	140	16.7	*166	12.0	-	-	2	-	2233	21.4
Sum of Yearly % increases		421.3		320.5		485.7						395.2
Av. Ann. %Incr. (1938-1946)		52.7		40.1		60.7						49.4
Av. Ann. %Incr. (1939-1946)		23.4		30.3		31.7						22.8
1st. 3 Mos. 1946	1779		124		158				2		2061	
1st. 3 Mos. 1947	2109	18.5	142	14.5	178	12.7			2		2431	18.0

*Large increases or decreases due in part to change in manner of classification.

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TABLE III (b)
COMPARATIVE ANNUAL OPERATING STATISTICS
AVERAGE MONTHLY KWH CONSUMPTION

MINNESOTA 1 KANABEC

YEAR	FARM NUMBER	FARM %INCR	NON-FARM NUMBER	NON-FARM %INCR	COMMERCIAL NUMBER	COMMERCIAL %INCR	LARGE POWER NUMBER	LARGE POWER %INCR	OTHER NUMBER	OTHER %INCR	TOTAL NUMBER	TOTAL %INCR
1938	46		46		110		578		12		55	
1939	47	6.5	55	19.6	132		1073		19		58	5.5
1940	51	8.5	47	-14.5	*952						61	5.2
1941	56	9.8	42	-10.6	138						65	6.6
1942	65	16.1	41	-2.4	142						71	9.2
1943	77	18.5	45	9.8	233				21		81	14.1
1944	83	7.8	49	8.9	300				26		90	11.1
1945	88	6.0	52	6.1	234				*138		97	7.8
1946	100	13.6	56	7.7	265				137		109	12.4
Sum of yearly % Increases		86.8		24.6								71.9
Av. Ann. %Incr. (1938-1946)		10.9		3.1								9.0
Av. Ann. %Incr. (1939-1946)		11.5		0.7								9.5
1st 3 Mos. 1946	103		54		218				159		109	
1st 3 Mos. 1947	119	15.5	67	24.1	263	20.6			181	13.8	126	15.6

*Large increases or decreases due in part to change in manner of classification.

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this purpose and it is expected that more than 500 miles of additional line will be completed by the end of 1949. Additional lines will be constructed as funds become available. It is estimated that a total of 4,454 farms will be served by the end of 1949, 6,337 by the end of 1952, and 7,511 by the end of 1957. These figures include 789 rural consumers which will be acquired from the Eastern Minnesota Power Corporation.

In order to estimate the kilowatt hour consumption of farm consumers at the end of each of the above periods, estimates of the percent saturation of appliances among existing consumers of the Association were made. These estimates were facilitated by a survey conducted by the Association for this purpose and are included in Table IV. Based on data collected in the area and in consideration of the opinions of various county agents and other authorities in the area, estimates of the percent saturation of appliances among farm consumers were also tabulated for the end of the 10-year period terminating in 1957. These estimates are shown in Table V. It will be seen from Table V that the average monthly kilowatt hour consumption among farm consumers in the area is expected to reach approximately 500 by 1957. In consideration of these factors and other data included in the report it is conservatively estimated that the average monthly consumption of farm consumers will be 180 kilowatt hours in 1949, 275 kilowatt hours in 1952 and 450 kilowatt hours in 1957. Corresponding estimates of unit kilowatt demand values per farm have been taken from Engineering Memorandum No. 33R3 of the Engineering Division, Rural Electrification Administration, dated May 20, 1946. Power requirements and maximum kilowatt demands resulting from the above estimates of consumption have been tabulated for each delivery area and are included in Tables VIII to XIII.

TABLE IV
ESTIMATED PERCENT SATURATION OF APPLIANCES AS OF MARCH 31, 1947

DOMESTIC APPLIANCES

	Percent
Lights	100
Refrigerator	47.9
Radio	100
Washing Machine	95.8
Iron	95.8
Clock	11.2
Hot Plate	25.4
Hot Water Heater	2.0
Vacuum Cleaner	14.1
Toaster	46.5
Deep Freeze	4.2
Range	7.05
Coffee Maker	5.6
Waffle Iron	8.45
Food Mixer	7.05
Roaster	4.2
Water Pumps	2.0
Miscellaneous	-

FARM EQUIPMENT

Lights	
(1) Barn	88.7
(2) Poultry House	64.8
(3) Brooder House	11.2
(4) Pump House	15.5
(5) Granary	25.4
(6) Yard Lights	84.5
(7) Milk House	9.85
(8) Shop Lights	12.7
(9) Sheep Shed Lights	1.4
(10) Hog House	2.8
Milking Machine	46.5
Dairy Water Heater	4.2
Grain Elevator	1.4
Shop Motor	19.7
Air Compressor	1.4
Chick Brooder	5.63
Electric Fence	1.4
Cream Separator	2.8
Hay Hoist	1.4
Stock Water Pumps	54.9
Miscellaneous	-

TABLE V

ESTIMATES OF PERCENT SATURATION OF APPLIANCES ON FARMS IN 1957

APPLIANCE DOMESTIC-FARM HOME	Estimated Percent Saturation per 100 Consumers in 1957	Average Monthly KWH per Unit Appliance	Total Monthly KWH
Lighting	100	30	3,000
Home Freezers	15	75	1,125
Iron	95	5	475
Radio	103	8	824
Range	20	100	2,000
Refrigerator	85	35	2,975
Washing Machine	95	3	285
Water Heater	35	240	8,400
Water Pump (Pressure)	70	20	1,400
Milk Pasteurizer	65	30	1,950
SUB-Total			22,434
Other Miscellaneous Appliances @10% of total use			2,492
TOTAL - Monthly KWH per 100 Consumers - Domestic			24,926
Average Monthly Domestic Consumption per consumer			249 KWH

APPLIANCE: Farm Equipment	Estimated Percent Saturation per 100 Consumers in 1957	Average Yearly KWH per Unit Appliance	Total Yearly KWH
Dairy Barn Lighting	70	150	10,500
General Barn Lighting	24	80	1,920
Poultry House Lighting	50	40	2,000
Yard Lighting	90	120	10,800
Barn Ventilating Fans	25	200	5,000
Brooder-Chick	25	500	12,500
Milk Cooler (5 cans/day)	52	1800	93,600
Milking Machine	70	500	35,000
Dairy Water Heater	40	1500	60,000
Stock Water Pump	70	400	28,000
Barn Cleaner	25	120	3,000
Poultry Water Warmer	40	120	4,800
Hay Driers (@ 60 Tons)	5	3000	15,000
SUB-TOTAL			282,120
Miscellaneous uses @5% of total use			14,848
Total Yearly KWH per 100 Consumers - Farm Equipment			296,968
Average Monthly KWH per 100 Consumers - Farm Equipment			24,747
Average Monthly KWH per Consumer - Farm Equipment			247 KWH

Total Average Monthly Consumption Per Farm

(1)	Domestic	249 KWH
(2)	Farm Equipment	247 KWH
	TOTAL	496 KWH

Non-Farm: The number of non-farm consumers presently served by the Association is relatively small, numbering approximately 142. These consumers Consist of non-farm, residential consumers, seasonal cottages, schools and public buildings and other miscellaneous consumers. The increase in the number of non-farm consumers in the area is not expected to be rapid. Such increases are not accurately predictable at this time since increases will be in the form of new residences constructed and in a slight increase in the number of seasonal cottages and resort facilities in the area. Based on opinions expressed by the project manager and by others familiar with the area, the number of non-farm consumers of all types that the Association will be serving has been estimated at 236 in 1949, 354 in 1952 and 439 in 1957.

The average monthly kilowatt hour consumption to be attained by non-farm consumers in 1957 was derived from an adjustment of the indicated saturation of domestic appliances for farm use together with a knowledge and consideration of other factors affecting the consumption of rural residential, seasonal and other types of non-farm establishments. Based on these factors the average kilowatt hour consumption of all non-farm consumers has been estimated at 100 kilowatt hours by the end of 1949, 150 kilowatt hours by the end of 1952, and 205 kilowatt hours by the end of 1957. Average unit kilowatt demands per consumer have been derived from the curves accompanying REA Engineering Memorandum No. 33R3, dated May 20, 1946. Power requirements and maximum kilowatt demands resulting from these estimates are included in Tables VIII to XIII for each substation area.

Commercial: As in the case of non-farm consumers the number of commercial consumers in rural areas to be served by the Association will be relatively small. The number of such consumers served at the present time totals 178,

9 of which consist of service to creameries, locker plants, feed mills, etc., and have been individually tabulated in the estimates of loads. The increase in the number of such consumers will not be large and estimates place the number of these consumers to be served by the Association at 245 in 1949, 344 in 1952 and 369 in 1957.

The estimates of average consumption among commercial consumers have been taken from an average of more than 1,174 commercial consumers in the area now served by the Eastern Minnesota Power Corporation and an established rate of increase experienced on this type of consumer during the last ten years. Such estimates have placed the average monthly kilowatt hour consumption of commercial consumers at 200 kilowatt hours by the end of 1949, 320 kilowatt hours by the end of 1952 and 410 kilowatt hours by the end of 1957. Average unit kilowatt demand values have been similarly derived from Engineering Memorandum No. 33R3 mentioned above.

House Heating: While no known electric house heating installations are served at present, either by the Association or by the Eastern Minnesota Power Corporation, recent developments of and consumer interest in this type of equipment, (thermostatically controlled radiant installations as well as the so-called "heat pump") make it apparent that this type of load should not be entirely disregarded in any estimate of future loads.

The degree of saturation of these installations is not readily foreseeable, however, an acceptable method of estimating the probable rate of development has been arrived at on the following basis: It is estimated by local authorities that the rate of dwelling replacement in the area is approximately 3% per year. It is estimated that at least 2½% of the dwellings replaced or remodeled will be insulated and equipped with some form of electric heating installation. Based on the foregoing the number of house heating installations to be served from the Association's rural

lines is estimated to be 10 in 1949, 28 in 1952 and 60 in 1957. Since the "heat pump" appears to be the most efficient and economical method of electric house heating it has been selected on which to base kilowatt hour consumption and demands. Experiments conducted by manufacturers of this type of equipment and available data indicate that the average dwelling in this area equipped with this type of installation will consume approximately 10,000 kilowatt hours annually for heating and 5,000 kilowatt hours annually for summer air conditioning, making a total of 15,000 kilowatt hours annual average consumption. Installations of this type have an individual maximum demand of from 3.5 to 7 kilowatts. It is assumed for load estimating purposes that the average installation will have a maximum demand of 5 kilowatts and since the number of installations estimated for each delivery point are comparatively small no diversity factor has been applied to this type of load. The power requirements and estimated kilowatt demands for house heating have been tabulated separately in Tables VIII to XIII for each point of delivery.

Rural Industry: Industrial development stemming mainly from the important milk industry is confined largely to the towns and villages throughout the Association's area now being served by the Eastern Minnesota Power Corporation, a discussion of which will appear in Part 2 of this section of the report. The Association is at present serving 6 creameries, 2 feed mills and 1 locker plant. A locker plant is included as a part of one of the creameries. Other than 1 feed mill at Estes Brook and a locker plant at Ramey, there are no new industries of this type included in the estimates of loads. Each of the foregoing industrial loads are tabulated separately in Tables VIII to XIII. Estimated annual kilowatt hour consumption of each establishment has been based on present requirements increased at the rate of 10% in 1949, an additional 10% in 1952 and 5% in 1957. Maximum

kilowatt demands have been based on present installed horsepower requirements and known plans of future expansion to which have been applied suitable diversity factors.

Street Lighting: The Association is now serving small street lighting systems in villages of Day and Dalbo. It is anticipated that similar systems will be served in the villages of Santiago and Hillman within the forecast period. Kilowatt hour requirements are based on past experience and have been increased at the same rates as set forth for rural industries. Maximum demands have been estimated at 2 kilowatts for each system.

Acquisition of Farmer-Owned Lines: The W-A-C-K Cooperative Electric Association serves approximately 100 rural farm consumers in the Association's area adjacent to the village of Mora. It is probable that the farm members of that cooperative will be desirous of obtaining electric service from the Association's lines within the next five years. These farms have been included in the load estimates of Table VIII for 1952 at the same power requirements and kilowatt demands as other farms to be served from the Association's lines.

Part 2--Eastern Minnesota Power Corporation Acquisition:

The types of loads which will be served in towns and villages as a result of the acquisition of the distribution facilities of Eastern Minnesota Power Corporation are discussed in the following pages. Rural farm loads to be served as a result of the acquisition have been included in Part 1 of this section and tabulated separately with rural loads of the Association.

In determining the types of loads in towns and villages now served by the Eastern Minnesota Power Corporation, operating records of that corporation were analyzed in order to secure pertinent information relative to the number and types of consumers and average kilowatt hour consumption

of each class of consumer for each of the 18 towns and villages included in the acquisition. Each of the district offices were visited and meter reading books examined to secure data on the horsepower connected load and kilowatt hour consumption on individual loads of all industrial consumers. These data are tabulated in Tables XIV to XXXI for each town served. The number of water heaters in each town was tabulated in order to determine trends in increased saturation of large energy consuming appliances. Other saturation data were not readily available.

Table VI below reflects tha average annual increase in consumption for residential, rural and commercial consumers served by the Corporation from 1935 to 1946, inclusive. The average rate of increase in kilowatt hour consumption for residential and commercial consumers as derived from this table was used as a basis for determining the rate of future increase in kilowatt hour consumption for these two types of consumers.

TABLE VI
EASTERN MINNESOTA POWER CORP.
RATE OF AVERAGE ANNUAL KWH CONSUMPTION

YEAR	TYPE OF CONSUMER					
	RESIDENTIAL		RURAL		COMMERCIAL	
	KWH CONS.	% INCREASE	KWH CONS.	% INCREASE	KWH CONS.	% INCREASE
1935	630		707		973	
1936	717	13.8	819	15.8	1138	11.7
1937	732	2.1	838	2.3	1325	16.4
1938	742	1.4	994	18.6	1600	20.8
1939	787	6.1	987	-0.7	1660	3.8
1940	861	9.4	1053	6.7	1856	11.8
1941	909	5.6	1112	5.6	1961	5.7
1942	930	2.3	1144	2.9	1998	1.9
1943	966	3.9	1219	6.6	1978	-1.0
1944	1020	5.6	1239	1.6	2227	12.6
1945	1083	6.2	1342	8.3	2358	5.9
1946	1200	10.8	1483	10.5	2740	16.2
TOTAL		67.2		78.2		105.8
AVERAGE		6.1		7.1		9.6

In determining the increase in the number of residential, commercial and small power consumers for each town in each period of the estimates, growths in population for the various towns were estimated based on the

rate of increase in population as derived from the 1920, 1930 and 1940 census data where available and on other information available from persons familiar with the entire area under study. From this population data the future number of each of the above three types of consumers were determined in the same ratio as the present number of such consumers bears to the estimated projected population of each town. Population data from which the above estimates are derived is included in Table VII.

TABLE VII
POPULATION DATA - VILLAGES AND TOWNS

TOWNS	POPULATION US CENSUS DATA 1920	1930	1940	ESTIMATED POPULATION 1947	1957
Braham	511	579	578	650	800
Grandy	-	-	-	100	110
Grasston	-	-	144	150	200
Stanchfield	-	-	-	150	175
Gilman	-	-	-	100	110
Foreston	328	280	300	350	400
Ronneby	-	-	-	70	75
Pease	-	-	-	175	200
Beroun	-	-	-	110	125
Oak Park	-	-	-	100	110
Bock	-	-	125	150	175
Ogilvie	436	344	438	475	600
Milaca	1347	1318	1627	1850	2225
Cambridge	1080	1183	1592	2000	2400
Pine City	1303	1343	1718	2200	2650
Rush City	971	908	1020	1150	1325
Harris	672	584	609	650	700
Rock Creek	-	-	70	100	110

Future growth in number of consumers and the rate of increase in kilowatt hour consumption by classes of consumers is discussed for each class of consumers in the following paragraphs.

Residential: The total number of residential consumers now served by the Eastern Minnesota Power Corporation in the 18 towns and villages is approximately 2,651 as of February 28, 1947. Based on population data included in Table VII above, it is estimated that the number of residential consumers will increase to 2,865 by 1949, 3,026 by 1952 and 3,305 by 1957. Individual increases in the number of consumers for each town are tabulated in Tables XIV to XXXI of the Load Estimates.

Table VI indicates that the average annual rate of increase in kwh consumption for all residential consumers in the towns and villages to be acquired was 6.1% from 1935 to 1946, inclusive. Attention is invited to the increase of 10.8% in average consumption for the year 1946 over that of 1945. Based on the foregoing and a consideration of other factors relating to residential consumption, the estimated future kwh consumption for residential consumers has been based on an average annual increase of 10% per year from 1946 to 1949, 6% per year from 1950 to 1952 and 5% per year from 1953 to 1957.

Considerable increase in the saturation of hot water heaters is evident in a number of towns and villages served in the acquisition. Saturation data on such appliances have been determined for some of the major towns as follows:

Towns	Percent
Pine City	13.3
Braham	11.3
Cambridge	10.3
Rush City	8.9
Ogilvie	8.1
Malaca	7.8

Water heaters and other major appliances are rapidly being added throughout the towns and villages served and a considerable increase in kilowatt hour consumption is expected to result in all of the towns served. Similar increases in saturation of major appliances is evident throughout the area, the municipal plants at Mora reporting approximately 25% saturation of water heaters; North Branch, 15% of water heaters and 25% of ranges; and Princeton, approximately 9.2% saturation of water heaters.

In view of the trends in the increased use of the above equipment it is not unlikely that the kilowatt hour consumption of residential consumers in the acquisition will exceed the estimates upon which loads for this class of consumers have been determined. The estimates of loads of residential

consumers are tabulated in Tables XIV to XXXI for each town included in the acquisition.

Commercial: The Eastern Minnesota Power Corporation serves approximately 772 commercial consumers in the towns and villages to be acquired as of February 28, 1947. The increase in the number of commercial consumers to be served during the forecast period has been based on the same considerations as were residential consumers as reflected in Table VII and are estimated to be 832 in 1949, 885 in 1952 and 961 in 1957.

Table VI reflects that the average annual increase for all commercial consumers served from 1935 to 1946, inclusive, was 7.1%. Attention is invited to the increase of 10.5% in the average consumption for 1946 over that of 1945. Based on the foregoing and a consideration of other factors expected to influence average commercial consumption it is estimated that an average annual increase of 10% per year from 1946 to 1952, and 6% per year from 1953 to 1957 will be experienced. Loads resulting from the above estimates for commercial consumers are tabulated in Tables XIV to XXXI for each town.

Small Power: The Corporation is now serving a number of power consumers, most of which are classified as small power. For purposes of clarity in the estimates, the larger of these have been treated individually and are discussed below under "Additional Itemized Small Power." The remainder, consisting of all types of small 3-phase and medium single-phase consumers, are treated under this section for purposes of estimating. On February 28, 1947 the Corporation was serving a total of approximately 80 such consumers in addition to those treated individually in the table of load estimates for the respective towns. The estimated increase in the number of this type of consumer has been arrived at on a population basis in the same manner as was used in arriving at the number of residential and commercial consumers for each of the individual towns and villages involved.

Present kilowatt hour consumption of small power consumers was arrived at by deleting the consumption of the larger individually treated power consumers and extracting an average annual consumption for the balance. Estimates of increased consumption were arrived at by a consideration of various factors affecting anticipated consumption in these groups by applying an average annual increase of 5% per year to the present consumption from 1946 thru 1956. This method appears to be consistent with increases as reflected by the past operating experience of the Corporation. The number of consumers and kilowatt hour requirements for small power consumers in each of the towns and villages now being served are tabulated in Tables XIV to XXXI.

Additional Itemized Small Power: In analyzing the operating records of the Corporation a number of small power loads worthy of individual treatment were discovered. These consist of service to creameries, locker plants, feed mills and other miscellaneous small power loads having comparatively large connected horsepower and kilowatt hour consumption. These have been listed in the Tables of Estimates by name, showing the total horsepower connected load of each establishment as of February 28, 1947, as well as the average kilowatt hour consumption for the twelve months ending February 1947. No increases in the number of such consumers have been included. The increase in kilowatt hour consumption for each load included in this category has been based upon an estimated 10% for the period 1947-1949, an additional 10% for the period 1950-1952 and 5% for the period 1953-1957.

The serving of a number of such industrial loads in several of the larger towns and villages is a major factor in the time of occurrence of the maximum kilowatt demand experienced in those towns. This influence is reflected in the peak demand of the entire system of the Corporation

in that its peak normally occurs during the day time. This same day-peak characteristic will be noted in several of the larger towns which serve feed mills, creameries, locker plants, etc.

For the reasons set forth above and because the Corporation has not installed demand meters on the individual town substations, no estimates of demands have been included in the load estimates for individual towns; however, such might be arrived at by applying suitable demand factors to the larger loads. For purposes of estimating demands in the towns, the following demand factors may be used: Creameries - 75%; Feed mills - 90%; Locker plants - 100%; Braham Granite Works - 60%. In arriving at contributed demands of each individual load to over-all system demands suitable diversity factors should then be applied.

Large Power: The Corporation serves several large power consumers located mainly in the towns and villages. These are as follows:

Location	Consumer	Connected Hp.	Estimated Demand Factor	Annual Consumption
Cambridge	Hercules Power Company	116	70	290,140
Pine City	Pine City Co-op. Creamery	102	75	239,000
Pine City	Pine City Dairy	145	75	355,712
Rush City	Farmers Union Grain Terminal Ass'n.	550	70	2,088,000
Rush City	Land O'Lakes Creamery	77.5	75	312,000
Rush City	Maple Island Farm, Inc.	78	75	360,000

No increase in the number of these consumers has been included in the load estimates.

Estimated kilowatt hour consumption has been arrived at in the same manner as kilowatt hour consumption for additional itemized small power consumers. Likewise, individual demands have been omitted for the same reasons as those enumerated above but may be arrived at in the same manner as that described for "Additional Itemized Small Power."

Municipal: This class of consumer now served by the Corporation includes service to municipal water systems, street lighting and other municipal requirements. Service to pumps, street lighting and disposal plants has been treated individually in the estimates of loads and the remaining municipal loads have been treated as "Other Municipal." No increase in the number of municipal consumers has been included in the load estimates. Future increases in kilowatt hour consumption for such loads has been based upon a 10% increase for the period 1946-1949, and an additional 10% for the period 1950-1952 and 5% for the period 1953-1957.

System Losses: In order to arrive at the total kilowatt hour requirements in each of the towns and villages system losses have been applied. Corporation records examined indicated that over-all transmission and distribution losses were approximately 20% for the past 15 months operation. Of this percentage, 5% is assumed to have been occasioned by transmission and substation losses. The remainder, 15%, has been applied in arriving at the system losses in each of the towns for the load estimates in 1949 and 1952. This has been reduced to 13% in arriving at losses for 1957.

ESTIMATED ULTIMATE SYSTEM INVESTMENT

In order to arrive at a fair basis on which a long range rate structure may be considered it is necessary to arrive at an approximation of the total system investment which the Association will be obliged to make to construct the necessary facilities to serve the estimated loads.

Tables VIII to XIII, inclusive, indicate that a total of 8,394 rural consumers, 789 of which are now served by Eastern Minnesota Power Corporation, will be served by the Association. The Association is now serving a total of approximately 2,500 consumers and operates approximately 960 miles of line, reflecting an overall consumer density of 2.6 consumers per mile. The fulfillment of area coverage plans of the Association is expected to result in an overall rural consumer density of approximately 3 consumers per mile.

On the above basis the estimated ultimate total miles of rural line is 2,535 miles, exclusive of rural lines included in the acquisition. This mileage is estimated to consist of the following:

Three phase line	336 miles	
"V" phase lines	228 miles	
Single phase lines	1,756 miles	
Services (@ 150 feet)	215 miles	
Total rural distribution lines	2,535 miles	(exclusive of acquisition)

The estimated ultimate cost of rural distribution lines is dependent upon the original cost of existing facilities and the present and future costs of facilities to be constructed. The following table is based on the cost of existing lines when constructed and the anticipated cost of future construction. Acquisition costs of the Eastern Minnesota Power Corporation properties have been included at the amounts allocated for this purpose.

Estimates contained herein are necessarily preliminary and are subject to revision and change which may be occasioned by the final results dictated by the ultimate system design study to be prepared by the project engineer.

ESTIMATE OF ULTIMATE SYSTEM INVESTMENT

Existing Distribution Lines:

3-phase	56 miles		
"V" phase	36 miles		
1 phase	794 miles		
Services	74 miles		
Total	960 miles		$ 930,000

New Distribution Lines to be Constructed:

3-phase	280 mi @ $1350	$266,000	
"V" phase	192 mi @ $1150	220,800	
1 phase	962 mi @ $ 950	913,900	
Services	141 mi @ $1100	155,100	
Total	1,575 miles		1,555,800

Cost of Re-phasing and Reconductoring 54,200

Acquisition E.M.Pr.Co.

Purchase Price	$743,901	
Rehab.,Eng.,Leg.,etc.	203,099	947,000

TOTAL DISTRIBUTION LINES AND ACQUISITION $3,487,000

Miscellaneous Physical Plant

Meters	$ 95,000	
Office Furn. and Fixtures	15,000	
Transportation Equipment	25,000	
Office Bldgs., and Real Estate	80,000	
Lab. Testing Equipment	5,000	
Tools and Working Equipment	15,000	
Communication Equipment	15,000	
Inventory of Materials	35,000	
Total Misc. Physical Plant		$ 285,000

TOTAL PHYSICAL PLANT 3,772,000

General Overhead (Less Acquisition):

Organization Exp.	$ 19,000	
Misc. Construction Exp. @ 2%	56,000	
Engineering and Supervision @ 5%	141,000	
Legal Expense @ 1/2%	14,000	
Interest during construction @ 2.5%	71,000	
Total General Overhead		301,000

GRAND TOTAL INVESTMENT $4,073,000

TABLE VIII
ESTIMATE OF LOADS – RURAL
DELIVERY POINT "AA" – COIN

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	NUMBER OF CONSUMERS			KILOWATT DEMAND			ANNUAL KILOWATT HOUR CONSUMPTION		
	1949	1952	1957	1949	1952	1957	1949	1952	1957
Farms (on Ass'n lines)	693	1066	1311	@ 0.64 443	@ 0.93 992	@ 1.43 1,875	@ 2160 1,496,880	@ 3300 3,517,800	@ 5400 7,079,400
Farms (E. M. Pr. Corp.)	276	276	276	@ 0.64 176	@ 0.93 256	@ 1.43 394	@ 2160 596,160	@ 3300 910,800	@ 5400 1,490,400
Non-Farm	44	62	75	@ 0.40 18	@ 0.54 33	@ 0.69 52	@ 1200 52,800	@ 1800 111,600	@ 2460 184,500
Commercial	58	72	75	@ 0.77 45	@ 1.18 85	@ 1.35 101	@ 2400 139,200	@ 3860 277,920	@ 4920 369,000
House Heating (Heat pumps)	2	6	13	@ 5/1.0D.F 10	@ 5/1.0D.F 30	@ 5/1.0D.F. 65	@ 15,000 30,000	@ 15,000 90,000	@ 15,000 195,000
Dalbo Creamery and Locker Plant (3Ø)	1	1	1	@ 30/2.0D.F 15	@ 30/2.0D.F 15	@ 30/2.0D.F. 15	40,000	44,000	46,000
Dalbo Feed Mill (3Ø)	1	1	1	@ 50/2.0D.F. 25	@ 50/2.0D.F. 25	@ 50/2.0D.F. 25	16,500	18,150	19,060
Day Coop. Creamery (3Ø)	1	1	1	@ 25/2.0D.F. 13	@ 25/2.0D.F. 13	@ 25/2.0D.F. 13	33,000	36,300	38,115
Day Feed Mill (3Ø)	1	1	1	@ 50/2.0D.F. 25	@ 50/2.0D.F. 25	@ 50/2.0D.F. 25	16,500	18,150	19,060
Day Locker Plant	1	1	1	@ 7/2.0D.F. 4	@ 7/2.0D.F. 4	@ 7/2.0D.F. 4	15,400	16,940	17,800
Street Lighting	2	2	2	4	4	4	@ 1760 3,520	@ 2000 4,000	@ 2100 4,200
Acquisition of: W-A-C-K Electric Assn's Mora (Farmer owned)		100	100		@ 0.93 93	@ 1.43 143		@ 3300 330,000	@ 5400 540,000
Sub-Total	1080	1589	1857	778	1,575	2,716	2,439,960	5,375,660	10,002,535
plus System Losses							@ 22% 688,040	@ 20% 1,343,340	@ 18% 2,195,465
TOTALS	1080	1589	1857	778	1,575	2,716	3,128,000	6,719,000	12,198,000

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TABLE IX
ESTIMATE OF LOADS - RURAL
DELIVERY POINT "B" - LONG SIDING

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	NUMBER OF CONSUMERS			KILOWATT DEMAND			ANNUAL KILOWATT HOUR CONSUMPTION		
	1949	1952	1957	1949	1952	1957	1949	1952	1957
Farms (on Assn's Lines)	582	805	951	@ 0.66 384	@ 0.96 773	@ 1.48 1,407	@ 2160 1,257,120	@ 3330 2,656,500	@ 5400 5,135,400
Non-Farm	36	44	50	@ 0.41 15	@ 0.55 24	@ 0.69 35	@ 1200 43,200	@ 1800 79,200	@ 2460 123,000
Commercial	44	60	64	@ 0.72 32	@ 1.13 68	@ 1.31 84	@ 2400 105,600	@ 3860 231,600	@ 4920 314,880
House Heating (Heat Pumps)	1	4	8	@ 5/1.0D.F 5	@ 5/1.0D.F 20	@ 5/1.0D.F 40	@ 15,000 15,000	@ 15,000 60,000	@ 15,000 120,000
Santiago Co-op Creamery	1	1	1	@ 25/2.0D.F 13	@ 25/2.0D.F 13	@ 25/2.0D.F 13	24,860	27,346	28,713
Glendorado Creamery	1	1	1	@ 30/2.0D.F 15	@ 30/2.0D.F 15	@ 30/2.0D.F 15	44,000	48,400	53,240
Estes Brook Feed Mill (3Ø)	1	1	1	@ 50/1.0D.F 50	@ 50/1.0D.F 50	@ 50/1.0D.F 50	16,500	18,150	19,060
Street Lighting	1	1	1	@ 2/1.0D.F 1	@ 2/1.0D.F 1	@ 2/1.0D.F 1	1,600	1,760	2,000
Sub-Totals	667	917	1077	515	964	1,645	1,507,880	3,122,956	5,796,293
Plus System Losses							@ 22% 425,120	@ 20% 780,044	@ 18% 1,272,707
TOTALS	667	917	1077	515	964	1,645	1,933,000	3,903,000	7,069,000

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TABLE X
ESTIMATE OF LOADS - RURAL
DELIVERY POINT "C" - MILACA

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	NUMBER OF CONSUMERS			KILOWATT DEMAND			ANNUAL KILOWATT HOUR CONSUMPTION		
	1949	1952	1957	1949	1952	1957	1949	1952	1957
Farms (On Assn's Lines)	643	892	1056	@ 0.78 501	@ 0.93 829	@ 1.48 1,562	@ 2160 1,388,880	@ 3300 2,943,600	@ 5400 5,702,400
Farms (E.M. Pr. Corp.)	114	114	114	@ 0.78 89	@ 0.93 106	@ 1.48 168	@ 2160 246,240	@ 3300 376,240	@ 5400 615,600
Non-Farm	33	57	75	@ 0.40 13	@ 0.55 31	@ 0.70 53	@ 1200 39,600	@ 1800 102,600	@ 2460 184,500
Commercial	32	66	75	@ 0.72 23	@ 1.17 77	@ 1.33 100	@ 2400 76,800	@ 3860 254,760	@ 4920 369,000
House Heating (Heat Pumps)	2	5	9	@ 5/1.00.F 10	@ 5/1.00.F 25	@ 5/1.00.F 45	@ 15,000 30,000	@ 15,000 75,000	@ 15,000 135,000
Sub-Totals	824	1134	1329	636	1,068	1,928	1,781,520	3,752,160	7,006,500
Plus System Losses							@ 22% 502,480	@ 20% 938,840	@ 18% 1,538,500
TOTALS	824	1134	1329	636	1,068	1,928	2,284,000	4,691,000	8,545,000

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TABLE XI
ESTIMATE OF LOADS - RURAL
DELIVERY POINT "D" - GILMAN

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	NUMBER OF CONSUMERS			KILOWATT DEMAND			ANNUAL KILOWATT HOUR CONSUMPTION		
	1949	1952	1957	1949	1952	1957	1949	1952	1957
Farms (on Assn's Lines)	710	1146	1434	@ 0.65 462	@ 0.90 1,031	@ 1.42 2,036	@ 2160 1,533,600	@ 3300 3,781,800	@ 5400 7,743,600
Farms (E. M. Pr. Corp.)	37	37	37	@ 0.65 24	@ 0.90 33	@ 1.42 52	@ 2160 79,920	@ 3300 122,100	@ 5400 199,800
Non-Farm	42	55	64	@ 0.40 17	@ 0.60 33	@ 0.65 42	@ 1200 50,400	@ 1800 99,000	@ 2460 157,440
Commercial	78	96	100	@ 0.71 55	@ 1.08 104	@ 1.35 135	@ 2400 187,200	@ 3860 370,560	@ 4920 492,000
Ramey Creamery (1Ø)	1	1	1	@ 25/2.0D.F 13	@ 25/2.0D.F 13	@ 25/2.0D.F 13	@ 24,000 24,000	@ 26,000 26,000	@ 28,000 28,000
Hillman Creamery (1Ø)	1	1	1	@ 25/2.0D.F 13	@ 25/2.0D.F 13	@ 25/2.0D.F 13	@ 24,000 24,000	@ 26,000 26,000	@ 28,000 28,000
Ramey Locker Plant (1Ø)	0	1	1	@ 8/2.0D.F 4	@ 8/2.0D.F 4	@ 8/2.0D.F 4		@ 16,940 16,940	@ 17,800 17,800
House Heating (Heat Pumps)	2	4	12	@ 5 10	@ 5 20	@ 5 60	@ 15,000 30,000	@ 15,000 60,000	@ 15,000 180,000
Street Lighting (Hillman)	0	1	1	2	2	2		@ 1600 1,600	@ 1760 1,760
Sub-Totals	871	1342	1651	600	1,253	2,357	1,929,120	4,504,000	8,848,400
Plus System Losses							@ 22% 543,880	@ 20% 1,126,000	@ 18% 1,942,600
TOTALS	871	1342	1651	600	1,253	2,357	2,473,000	5,630,000	10,791,000

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TABLE XII

ESTIMATE OF LOADS – RURAL

DELIVERY POINT "E" – PINE CITY

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	NUMBER OF CONSUMERS			KILOWATT DEMAND			ANNUAL KILOWATT HOUR CONSUMPTION		
	1949	1952	1957	1949	1952	1957	1949	1952	1957
Farms (on Assn's Lines)	469	635	744	@ 0.65 305	@ 0.95 603	@ 1.45 1,078	@ 2160 1,013,040	@ 3300 2,095,500	@ 5400 4,017,600
Farms (E. M. Pr. Corp.)	316	316	316	@ 0.65 205	@ 0.95 300	@ 1.45 458	@ 2160 682,560	@ 3300 1,042,800	@ 5400 1,706,400
Non-Farm	40	60	75	@ 0.40 16	@ 0.55 33	@ 0.70 52	@ 1200 48,000	@ 1800 108,000	@ 2460 184,500
Commercial	12	22	25	@ 0.72 9	@ 1.08 24	@ 1.31 33	@ 2400 28,800	@ 3860 84,920	@ 4920 123,000
House Heating (Heat Pumps)	2	4	9	@ 5 10	@ 5 20	@ 5 45	@ 15,000 30,000	@ 15,000 60,000	@ 15,000 135,000
Sub-Totals	839	1037	1169	545	980	1,666	1,802,400	3,391,220	6,166,500
Plus System Losses							@ 22% 508,600	@ 20% 847,780	@ 18% 1,353,500
TOTALS	839	1037	1169	545	980	1,666	2,311,000	4,239,000	7,520,000

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TABLE XIII

ESTIMATE OF LOADS - RURAL

DELIVERY POINT "F" - NORTH BRANCH

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	NUMBER OF CONSUMERS			KILOWATT DEMAND			ANNUAL KILOWATT HOUR CONSUMPTION		
	1949	1952	1957	1949	1952	1957	1949	1952	1957
Farms (on Assn's Lines)	568	904	1126	@ 0.66 375	@ 0.95 859	@ 1.46 1,644	@ 2160 1,226,880	@ 3300 2,983,200	@ 5400 6,080,400
Farms (E. M. Pr. Corp.)	46	46	46	@ 0.66 30	@ 0.95 44	@ 1.46 67	@ 2160 99,360	@ 3300 151,800	@ 5400 248,400
Non-Farm	41	76	100	@ 0.41 17	@ 0.54 41	@ 0.71 71	@ 1200 49,200	@ 1800 136,800	@ 2460 246,000
Commercial	21	28	30	@ 0.73 15	@ 1.09 30	@ 1.30 39	@ 2400 50,400	@ 3860 108,080	@ 4920 147,600
House Heating (Heat Pumps)	1	5	9	@ 5 5	@ 5 25	@ 5 45	@ 15,000 15,000	@ 15,000 75,000	@ 15,000 135,000
Sub-Totals	677	1059	1311	442	999	1,866	1,440,840	3,454,880	6,857,400
Plus System Losses							@ 22% 406,160	@ 20% 863,120	@ 18% 1,505,600
TOTALS	677	1059	1311	442	999	1,866	1,847,000	4,318,000	8,363,000

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TABLE XIV

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF BRAHAM

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	189	@ 1530 289,170	210	@ 2036 427,560	225	@ 2425 545,625	245	@ 3100 759,500
Commercial	68	@ 3110 211,480	70	@ 4139 289,730	74	@ 5507 407,518	80	@ 7355 588,400
Street Lighting	1	20,715	1	22,786	1	25,064	1	26,317
Village of Braham (Pump) 10 h.p.c.	1	10,564	1	11,620	1	12,782	1	13,421
Other Municipal	2	@ 3130 6,260	2	@ 3443 6,886	2	@ 3787 7,574	2	@ 3976 7,952
Small Power	8	@ 1871 14,968	8	@ 2160 17,280	9	@ 2500 22,500	10	@ 3185 31,850
ADD'T. ITEM. SM. PR.								
Braham Mill & Feed Co. (73 h.p.c.)	1	34,180	1	37,598	1	41,357	1	43,424
Pick Food Processing Co. (Locker Plant) (15 h.p.c.)	1	49,110	1	54,021	1	59,423	1	62,394
Braham Coop. Cry. (50 h.p.c.)	1	64,480	1	70,928	1	78,020	1	89,121
Braham Granite Works (123 h.p.c.)	1	67,750	1	74,525	1	81,977	1	86,075
Northwood Novelty Co. (28 h.p.c.)			1	24,000	1	26,400	1	27,720
Sub-Totals	273	768,677	297	1,036,934	317	1,308,240	344	1,736,174
Distribution Losses		@ 15% 135,648		@ 15% 182,988		@ 15% 232,404		@ 13% 259,428
TOTALS	273	904,325	297	1,219,922	317	1,540,644	344	1,995,602

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TABLE XV

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF GRANDY

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	27	@ 598 16,146	28	@ 800 22,400	29	@ 950 27,550	30	@ 1210 36,300
Commercial	11	@ 1875 20,625	11	@ 2500 27,500	12	@ 3320 39,840	12	@ 4445 53,340
Small Power	2	@ 1473 2,946	2	@ 1705 3,410	3	@ 1973 5,919	3	@ 2517 7,551
Sub-Totals	40	39,717	41	53,310	44	73,309	45	97,191
Distribution Losses		@ 15% 7,009		@ 15% 9,408		@ 15% 12,937		@ 13% 14,523
TOTALS	40	46,726	41	62,718	44	86,246	45	111,714

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XVI

ESTIMATE OF LOADS - EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF GRASSTON

MINNESOTA I KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	36	@ 1108 39,888	39	@ 1470 57,330	43	@ 1757 75,551	49	@ 2243 109,907
Commercial	15	@ 1957 29,355	17	@ 2600 44,200	19	@ 3467 65,873	21	@ 4639 97,419
Street Lighting	1	1,926	1	2,118	1	2,329	1	2,445
Small Power	2	@ 4276 8,552	2	@ 4950 9,900	3	@ 5730 17,190	4	@ 7307 29,228
ADD'T ITEM SM. PR: Farmers Co-op Cry. (95 h.p.c.)	1	50,200	1	55,220	1	60,742	1	63,779
Sub-Total	55	129,921	60	168,768	67	221,166	76	302,778
Distribution Losses		@ 15% 22,927		@ 15% 29,782		@ 15% 39,029		@ 13% 45,243
TOTALS	55	152,848	60	198,550	67	260,195	76	348,021

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XVII

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF STANCHFIELD

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	39	@ 917 35,763	41	@ 1220 50,020	44	@ 1450 63,800	47	@ 1850 86,950
Commercial	9	@ 2013 18,117	9	@ 2675 24,075	10	@ 3560 35,600	11	@ 4770 52,470
Other Municipal	1	1,966	1	2,162	1	2,378	1	2,497
Small Power	1	2,488	1	2,880	2	@ 3330 6,660	3	@ 4260 12,780
ADD'T ITEM. SM. PR: Stanchfield Cry. Co. (15 h.p.c.)	1	12,000	1	13,200	1	14,520	1	21,780
Stanchfield Milling Co. (75h.p.c.)	1	36,000	1	39,600	1	43,560	1	45,738
Sub-Totals	52	106,334	54	131,937	59	166,518	64	222,215
Distribution Losses		@ 15% 18,765		@ 15% 23,283		@ 15% 29,385		@ 13% 33,205
TOTALS	52	125,099	54	155,220	59	195,903	64	255,420

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XVIII

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF GILMAN

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	24	@ 852 20,448	24	@ 1135 27,240	25	@ 1350 33,750	26	@ 1725 44,850
Commercial	14	@ 1550 21,700	14	@ 2060 28,840	15	@ 2745 41,175	16	@ 3074 58,784
Small Power	1	@ 4250 4,250	1	@ 4920 4,920	2	@ 5690 11,380	2	@ 7260 14,520
ADD'L ITEM. SM. PR: Gilman Coop. Cry (30 h.p.c.)	1	25,000	1	27,500	1	30,250	1	31,762
Sub–Totals	40	71,398	40	68,500	43	116,555	45	149,916
Distribution Losses		@ 15% 12,600		@ 15% 15,618		@ 15% 20,568		@ 13% 22,401
TOTALS	40	83,998	40	104,118	43	137,123	45	172,317

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XIX

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF FORESTON

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	68	@ 467 31,756	71	@ 621 44,091	74	@ 739 54,686	79	@ 944 74,576
Commercial	23	@ 1336 30,728	24	@ 1779 42,696	25	@ 2368 59,200	26	@ 3168 82,368
Street Lighting	1	1,872	1	2,059	1	2,265	1	2,378
Small Power	3	@ 2515 7,545	3	@ 2911 8,733	4	@ 3370 13,480	5	@ 4300 21,500
ADD'L ITEM. SM. PR. Farmers Co-op Cry. Co. (30 h.p.c.)	1	15,000	1	16,500	1	18,150	1	19,057
Sub-Totals	96	86,901	100	114,079	105	147,781	112	199,879
Distribution Losses		@ 15% 15,335		@ 15% 20,131		@ 15% 26,079		@ 13% 29,867
TOTALS	96	102,236	100	134,210	105	173,860	112	229,746

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XX

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF RONNEBY

MINNESOTA 1 KANABEC –

TYPE OF CONSUMERS	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	17	@ 1395 23,715	19	@ 1856 35,264	20	@ 2210 44,200	21	@ 2820 59,220
Commercial	8	@ 1493 11,944	9	@ 1987 17,883	9	@ 2645 23,805	10	@ 3539 35,390
Street Lighting	1	1,200	1	1,320	1	1,452	1	1,524
Small Power	0		0		1	2,000	1	2,552
Sub-Totals	26	36,859	29	54,467	31	71,457	33	98,686
Distribution Losses		@ 15% 6,505		@ 15% 9,612		@ 15% 12,610		@ 13% 14,746
TOTALS	26	43,364	29	64,079	31	84,067	33	113,432

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XXI

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF PEASE

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	39	@ 766 29,874	40	@ 1020 40,800	42	@ 1215 51,030	45	@ 1550 69,750
Commercial	15	@ 1459 21,885	15	@ 1943 29,145	16	@ 2586 41,376	17	@ 3459 58,803
Street Lighting	1	1,080	1	1,188	1	1,307	1	1,372
Small Power	4	@ 3854 15,416	4	@ 4461 17,844	5	@ 5164 25,820	5	@ 6590 32,950
ADD'L ITEM. SM. PR. Farmers Co-op Cry. (30 h.p.c.)	1	36,000	1	39,600	1	43,560	1	45,738
Feed Mill (50 h.p.c.)	0		1	7,920	1	8,712	1	9,147
Sub-Total	60	104,255	62	136,497	66	171,805	70	217,760
Distribution Losses		@ 15% 18,397		@ 15% 24,087		@ 15% 30,318		@ 13% 32,538
TOTALS	60	122,652	62	160,584	66	202,123	70	250,298

APPLICATIONS AND LOANS DIVISION, REA, June 1947

TABLE XXII

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF BEROUN

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	27	@ 1105 29,835	28	@ 1460 40,880	29	@ 1739 50,431	31	@ 2220 68,820
Commercial	13	@ 1225 15,925	13	@ 1631 21,203	14	@ 2170 30,380	15	@ 2902 43,530
Street Lighting	1	1,200	1	1,320	1	1,452	1	1,525
Small Power	1	3,556	1	4,117	2	@ 4766 9,532	2	@ 6082 12,164
ADD'L ITEM. SM. PR. Beroun Coop. Cry. Co. (30h.p.c.)	1	36,000	1	39,600	1	43,560	1	45,738
Sub-Totals	43	86,516	44	107,120	47	135,355	50	171,777
Distribution Losses		@ 15% 15,267		@ 15% 18,903		@ 15% 23,886		@ 13% 25,667
TOTALS	43	101,783	44	126,023	47	159,241	50	197,444

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XXIII

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF OAK PARK

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	23	@ 754 17,342	25	@ 1003 25,075	26	@ 1193 31,018	27	@ 1523 41,121
Commercial	14	@ 1302 18,228	14	@ 1732 24,248	15	@ 2304 34,560	16	@ 3093 49,488
Street Lighting	1	1,152	1	1,267	1	1,394	1	1,464
Small Power	2	@ 2025 4,050	2	@ 2343 4,686	3	@ 2712 8,136	3	@ 3460 10,380
ADD'L ITEM. SM. PR.								
Oak Park Coop. Assn. (30 h.p.c.)	1	28,000	1	30,800	1	33,880	1	35,574
Feed Mill (50 h.p.c.)	1	7,200	1	7,920	1	8,712	1	9,147
Sub-Totals	42	75,972	44	93,996	47	117,700	49	147,174
Distribution Losses		@ 15% 13,406		@ 15% 16,587		@ 15% 20,770		@ 13% 21,991
TOTALS	42	89,378	44	110,583	47	138,470	49	169,165

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XXIV

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF BOCK

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	37	@ 744 27,528	40	@ 990 39,600	43	@ 1179 50,697	46	@ 1505 69,230
Commercial	18	@ 1172 21,096	20	@ 1560 31,200	21	@ 2075 43,575	22	@ 2777 61,094
Street Lighting	1	1,680	1	1,848	1	2,033	1	2,135
Small Power	1	@ 4186 4,186	1	@ 4845 4,845	2	@ 5608 11,216	3	@ 7156 21,468
ADD'L ITEM. SM. PR. Bock Coop. Cry. (30 h.p.c.)	1	18,000	1	19,800	1	21,780	1	22,869
Feed Mill (50 hp)	0		1	7,920	1	8,712	1	9,147
Sub-Totals	58	72,490	64	105,213	69	138,013	74	185,943
Distribution Losses		@ 15% 12,792		@ 15% 18,567		@ 15% 24,355		@ 13% 27,784
TOTALS	58	85,282	64	123,780	69	162,368	74	213,727

APPLICATIONS AND LOANS DIVISION, REA JUNE 1947

TABLE XXV

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF OGILVIE

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	116	@ 1195 138,620	120	@ 1590 190,800	130	@ 1895 246,350	149	@ 2420 360,580
Commercial	45	@ 1964 88,380	48	@ 2608 125,184	52	@ 3471 180 492	58	@ 4643 269,294
Street Lighting	1	11,976	1	13,173	1	14,490	1	15,215
Village of Ogilvie Pump (10 h.p.c.)	1	3,834	1	4,217	1	4,638	1	4,869
Small Power	1	@ 1940 1,940	2	@ 2245 4,490	3	@ 2598 7,794	5	@ 3315 16,575
ADD'L ITEM. SM. PR. Farmers Coop. Cry.(33 h.p.)	1	32,000	1	35,200	1	38,720	1	40,656
Clarence Nieman (56 h.p.c.)	1	10,000	1	11,000	1	12,100	1	12,705
Locker Plant (7½ hp)	0		1	12,000	1	13,200	1	13,860
Sub–Totals	166	286,750	175	396,064	190	517,784	217	733,754
Distribution Losses		@ 15% 50,602		@ 15% 69,893		@ 15% 91,373		@ 13% 109,641
TOTALS	166	337,352	175	465,957	190	609,157	217	843,395

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XXVI

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF MILACA

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End, 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	495	@ 1387 686,565	530	@ 1842 976,260	560	@ 2193 1,228,080	615	@ 2798 1,720,770
Commercial	123	@ 4318 531,114	140	@ 5749 804,860	148	@ 7650 1,132,200	159	@ 10,235 1,627,365
Street Lighting	1	52,790	1	58,069	1	63,876	1	67,070
Village of Milaca Pumps (1-3; 1-40; 1-15 hp)	1	84,000	1	92,400	1	101,640	1	106,722
Other Municipal	2	12,000	2	13,200	2	14,500	2	15,246
Small Power	14	@ 3500 49,000	15	@ 4052 60,780	17	@ 4689 79,713	20	@ 5983 119,660
ADD'L ITEM. SM. PR.								
Illinois Cooperage Co. (23h.p.c.)	1	25,200	1	27,720	1	30,492	1	32,017
Memorial Hospital	1	32,400	1	35,640	1	39,204	1	41,164
Farmers Coop. Cry. (98½h.p.c.)	1	132,000	1	145,200	1	159,720	1	167,706
Farmers Coop. Cry. (139h.p.c.)	1	50,400	1	55,440	1	60,984	1	64,033
Land O'Lakes Cry. Inc. (76½ h.p.c.)	1	36,000	1	39,600	1	43,560	1	45,738
Russell Cry. Co. (25½ h.p.c.)	1	42,000	1	46,200	1	50,820	1	53,361
Rum River Cry. (17 h.p.c.)	1	10,800	1	11,880	1	13,068	1	13,721
Ind. School District #13(32h.p.c.)	1	15,600	1	17,160	1	18,876	1	19,820
Sub-Totals	644	1,759,869	697	2,384,409	737	3,036,753	806	4,094,393
Distribution Losses		@ 15% 310,565		@ 15% 420,778		@ 15% 535,897		@ 13% 611,805
TOTALS	644	2,070,434	697	2,805,187	737	3,572,650	806	4,706,198

TABLE XXVII

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF CAMBRIDGE

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
		@ 1480		@ 1968		@ 2344		@ 2992
Residential	522	772,560	570	1,121,760	605	1,418,120	665	1,989, 680
		@ 3950		@ 5257		@ 6997		@ 9361
Commercial	142	560,900	155	814,835	165	1,154,505	185	1,731,785
Street Lighting	1	26,700	1	29,370	1	32,307	1	33,922
Village of Cambridge Pumps (37hpc)	1	74,908	1	82,400	1	90,640	1	95,172
		@ 1539		@ 1778		@ 2058		@ 2626
Small Power	14	21,546	16	28,448	18	37,044	22	57,772
ADDITIONAL ITEMIZED SMALL POWER:								
Isanti Co. Coop Locker Plant (3½hpc)	1	14,000	1	15,400	1	16,940	1	17,787
Engberg Locker Plant (5½hpc)	1	18,000	1	19,800	1	21,780	1	22,869
General Feed Mill (55hpc)	1	20,000	1	22,000	1	24,200	1	25,410
Cambridge Feed & Mill Co (138hpc)	1	100,000	1	110,000	1	121,000	1	127,050
Beans, Inc. (Processing) (29hpc)	1	18,000	1	19,800	1	21,780	1	22,869
Cambridge Laundry (27½ hpc)	1	36,000	1	39,600	1	43,560	1	45,738
Cambridge Co-op Cry. (34 hpc)	1	40,000	1	44,000	1	48,400	1	50,820
Cambridge Woolen Mills (45 hpc)	1	36,000	1	39,600	1	43,560	1	45,738
Farmers Produce Inc. (34 hpc)	1	14,000	1	15,400	1	16,940	1	17,787
LARGE POWER								
Hercules Powder Co (116 hpc)	1	290,140	1	319,154	1	351,070	1	368,624
Sub-Totals	690	2,042,754	753	2,721,567	800	3,441,846	884	4,653,023
		@ 15%		@ 15%		@ 15%		@ 13%
Distribution Losses		360,486		480,276		607,384		695,279
TOTALS	690	2,403,240	753	3,201,843	800	4,049,230	884	5,348,302

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XXVIII

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF PINE CITY

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual IWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	598	@ 1537 919,126	660	@ 2044 1,349,040	700	@ 2435 1,704,500	770	@ 3110 2,394,700
Commercial	132	@ 4155 548,460	141	@ 5524 778,884	152	@ 7352 1,117,504	166	@ 9847 1,634,602
Street Lighting	1	71,656	1	78,822	1	86,704	1	91,039
Village Pine City Pump(1-40;1-60hpc)	1	96,750	1	106,425	1	117,068	1	122,921
Village of Pine City Disposal(10½hp)	1	10,880	1	11,968	1	13,165	1	13,823
Small Power	16	@ 1063 17,008	18	@ 1229 22,122	21	@ 1421 29,841	26	@ 1812 47,112
ADDITIONAL ITEMIZED SMALL POWER								
Pine City Coop Assn(Feed Mill)(58hp)	1	10,000	1	11,000	1	12,100	1	12,705
Pine City High School (15hp)	1	5,000	1	5,500	1	6,050	1	6,353
Henning Anderson (Feed Mill)(12½hp)	1	1,000	1	1,100	1	1,210	1	1,271
Wm. Challeen (Locker Plant)(5½hpc)	1	30,000	1	33,000	1	36,300	1	38,115
Pine City Milling Co. (50 hpc)	1	7,200	1	7,920	1	8,712	1	9,147
Land O'Lakes Cry. (90hpc)	1	56,000	1	61,600	1	67,760	1	71,148
Coco-Cola Bottling Co. (16hpc)	1	15,000	1	16,500	1	18,150	1	19,058
Family Theatre (8 hpc)	1	4,800	1	5,280	1	5,808	1	6,099
Redemtorist Fathers Mon. (20hpc)	1	12,000	1	13,200	1	14,520	1	15,246
LARGE POWER								
Pine City Coop Cry. (102 hpc)	1	239,000	1	262,900	1	289,190	1	303,649
Pine City Dairy (Hansen Bros.) (145 hpc)	1	355,712	1	391,283	1	430,411	1	451,932
Sub-Totals	760	2,399,592	833	3,156,544	887	3,958,993	976	5,238,920
Distribution Losses		@ 15% 423,457		@ 15% 557,037		@ 15% 698,645		@ 13% 782,827
TOTALS	760	2,823,049	833	3,713,581	887	4,657,638	976	6,021,747

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TABLE XXIX

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF RUSH CITY

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	312	@ 1484 463,008	330	@ 1973 651,090	345	@ 2349 810,405	371	@ 2997 1,111,887
Commercial	82	@ 2624 215,168	86	@ 3487 299,882	90	@ 4642 417,780	97	@ 6217 603,049
Street Lighting	1	28,170	1	30,987	1	34,086	1	35,790
Village of Rush City Pump (15 h.p.c.)	1	23,755	1	26,130	1	28,743	1	30,180
Small Power	7	@ 3429 24,003	8	@ 3970 31,760	10	@ 4595 45,950	12	@ 5862 70,344
ADD'L ITEM SM. PR. Rush City Frozen Foods Locker (20½ hpc)	1	36,000	1	39,600	1	43,560	1	45,738
Rush City Mill & Feed Co (70½hpc)	1	36,000	1	39,600	1	43,560	1	45,738
LARGE POWER Farmers Union Grain Term. Assn. (550 hpc)	1	2,088,000	1	2,296,800	1	2,526,480	1	2,652,804
Land O'Lakes Cry. Inc. (77½ hpc)	1	312,000	1	343,200	1	377,520	1	396,396
Maple Island Farm Inc. (78 hpc)	1	360,000	1	396,000	1	435,600	1	457,380
Sub-Totals	408	3,586,104	431	4,155,049	452	4,763,684	487	5,449,306
Distribution Losses *		191,046		357,268		427,076		474,848
TOTALS	408	3,777,150	431	4,512,317	452	5,190,760	487	5,924,154

* Includes Large Power Losses @ 5%

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TABLE XXX

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF HARRIS

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	56	@ 1244 69,664	57	@ 1656 94,392	58	@ 1972 114,376	60	@ 2517 115,020
Commercial	27	@ 1340 36,180	33	@ 1779 58,707	34	@ 2368 80,512	35	@ 3174 111,090
Street Lighting	1	3,182	1	3,500	1	3,850	1	4,043
Small Power	3	@ 1614 4,842	3	@ 1869 5,607	3	@ 2163 6,489	4	@ 2760 11,040
ADD'L ITEM. SM. PR.								
Harris Co-op Cry. (30½ h.p.c.)	1	54,000	1	59,400	1	65,340	1	68,607
North Branch Mill Co. (40 h.p.c.)	1	6,000	1	6,600	1	7,260	1	7,623
Sub-Totals	89	173,868	96	228,206	98	277,827	102	353,423
Distribution Losses		@ 15% 30,683		@ 15% 40,272		@ 15% 49,028		@ 13% 52,810
TOTALS	89	204,551	96	268,478	98	326,855	102	406,233

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XXXI

ESTIMATE OF LOADS – EASTERN MINNESOTA POWER CORPORATION ACQUISITION

TOWN OF ROCK CREEK

MINNESOTA 1 KANABEC

TYPE OF CONSUMER	12 Mos. End. 2/28/47		1949		1952		1957	
	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH	Consumers	Annual KWH
Residential	26	@ 904 23,504	27	@ 1202 32,454	28	@ 1431 40,068	29	@ 1827 52,983
Commercial	13	@ 1162 15,106	13	@ 1547 20,111	14	@ 2059 28,826	15	@ 2760 41,400
Small Power	0		1	@ 1852 1,852	1	@ 2144 2,144	2	@ 2736 5,472
ADD'L ITEM. SM. PR.								
Rock Creek Coop Cry. (28 h.p.c)	1	19,200	1	21,120	1	23,232	1	24,393
North Branch Milling Co. (40h.p.c.)	1	10,800	1	11,880	1	13,068	1	13,722
Royal Coop. Cry. (27h.p.c.)	1	30,000	1	33,000	1	36,300	1	38,115
Sub-Totals	42	98,610	44	120,417	46	143,638	49	176,085
Distribution Losses		@ 15% 17,402		@ 15% 21,250		@ 15% 25,348		@ 13% 26,312
TOTALS	42	116,012	44	141,667	46	168,986	49	202,397

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TABLE XXXII
SUMMARY OF LOADS
TOWNS SERVED BY EASTERN MINNESOTA POWER CORP., ACQUISITION
IN ASSOCIATION'S AREA

MINNESOTA 1 KANABEC

NAME OF TOWN	TOTAL CONSUMERS				ANNUAL KWH REQUIREMENTS			
	12 Months Feb. 1947	1949	1952	1957	12 Months Feb. 1947	1949	1952	1957
Braham	273	297	317	344	904,325	1,219,922	1,540,644	1,995,602
Grandy	40	41	44	45	46,726	62,718	86,246	111,714
Grasston	55	60	67	76	152,848	198,550	260,195	348,021
Stanchfield	52	54	59	64	125,099	155,220	195,903	255,420
Gilman	40	40	43	45	83,998	104,118	137,123	172,317
Foreston	96	100	105	112	102,236	134,210	173,860	229,746
Ronneby	26	29	31	33	43,364	64,079	84,067	113,423
Pease	60	62	66	70	122,652	160,584	202,123	250,298
Beroun	43	44	47	50	101,783	126,023	159,241	197,444
Oak Park	42	44	47	49	89,378	110,583	138,470	169,165
Bock	58	64	69	74	85,282	123,780	162,368	213,727
Ogilvie	166	175	190	217	337,352	465,957	609,157	843,395
Milaca	644	697	737	806	2,070,434	2,805,187	3,572,650	4,706,198
Cambridge	690	753	800	884	2,403,240	3,201,843	4,049,230	5,348,302
Pine City	760	833	887	976	2,823,049	3,713,581	4,657,638	6,021,747
Rush City	408	431	452	487	3,777,150	4,512,317	5,190,760	5,924,154
Harris	89	96	98	102	204,551	268,478	326,855	406,233
Rock Creek	42	44	46	49	116,012	141,667	168,986	202,397
TOTALS	3,584	3,864	4,105	4,483	13,589,479	17,568,817	21,715,516	27,509,303

APPLICATIONS AND LOANS DIVISION, REA June 1947

TABLE XXXIII

SUMMARY OF POWER REQUIREMENTS

RURAL & EASTERN MINNESOTA POWER CORP., ACQUISITION

MINNESOTA 1 KANABEC

DELIVERY POINT LOCATION	NUMBER OF CONSUMERS			KILOWATT DEMAND			ANNUAL KILOWATT HOUR CONSUMPTION		
	1949	1952	1957	1949	1952	1957	1949	1952	1957
"AA" – Coin	1080	1589	1857	778	1575	2716	3,128,000	6,719,000	12,198,000
"B" – Long Siding	667	917	1077	515	964	1645	1,933,000	3,903,000	7,069,000
"C" – Milaca	824	1134	1329	636	1068	1928	2,284,000	4,691,000	8,545,000
"D" – Gilman	871.	1342	1651	600	1253	2357	2,473,000	5,630,000	10,791,000
"E" – Pine City	839	1037	1169	545	980	1666	2,311,000	4,239,000	7,520,000
"F" – North Branch	677	1059	1311	442	999	1866	1,847,000	4,318,000	8,363,000
System Total, REA (Includes E.M.Pr. Corp, Rural)	4958	7078	8394	3516	6839	12,178	13,976,000	29,500,000	54,486,000
Acquisition E. M. Pr, Corp., Towns Only	3864	4105	4483	@ 55% L.F. 3720	@ 55% L.F. 4510	@ 55% L.F. 5720	17,569,000	21,715,000	27,509,000
GRAND TOTAL	8822	11,183	12,877	7236	11,349	17,898	31,545,000	51,215,000	81,995,000

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